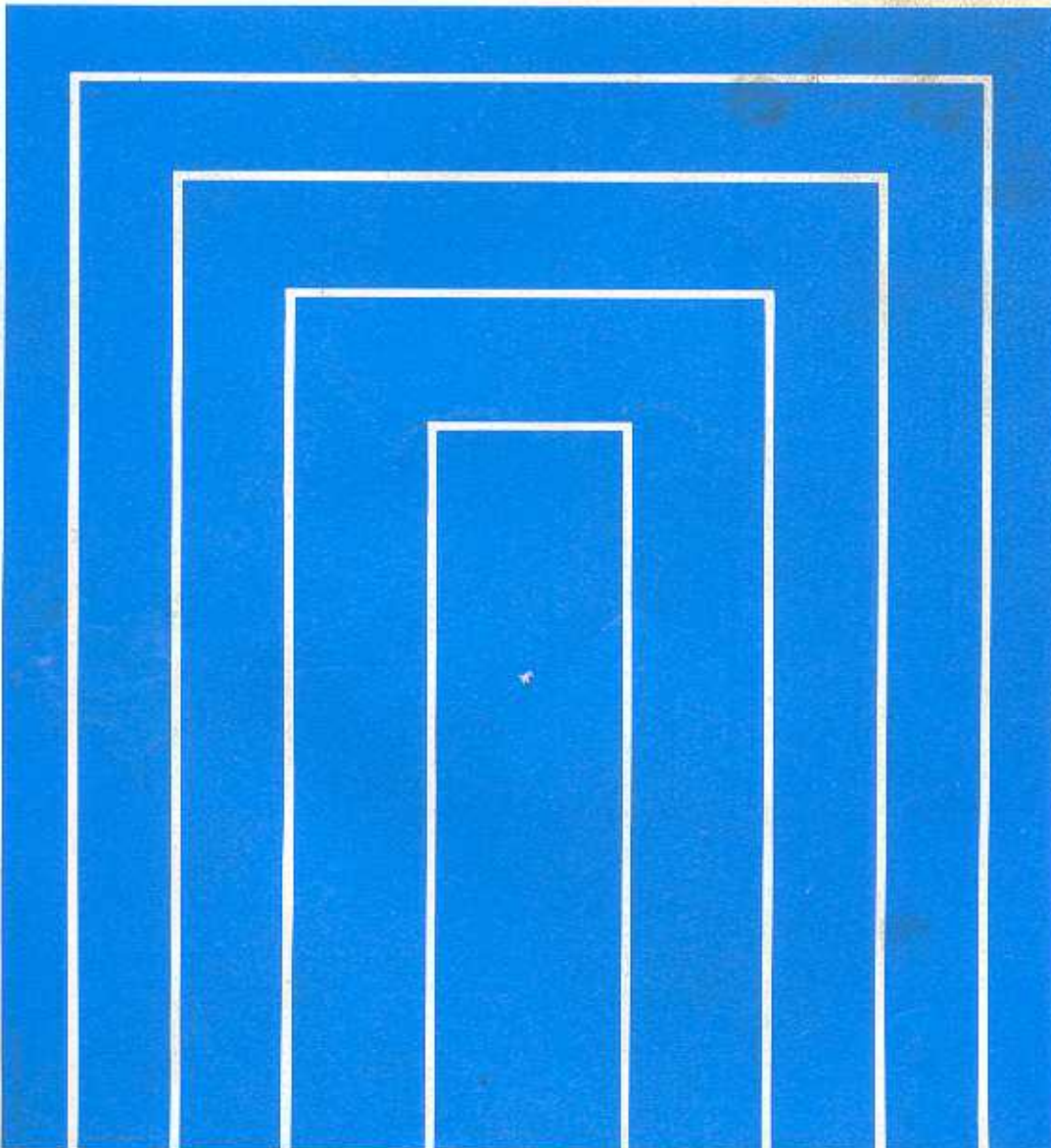




5L-E ENGINE

REPAIR MANUAL

Sep., 2002



431

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TERMS

ABBREVIATIONS USED IN THIS MANUAL

01-217-09

Abbreviations	Meaning
ABS	Anti-Lock Brake System
A/C	Air Conditioner
AC	Alternating Current
ACC	Accessory
ACIS	Acoustic Control Induction System
ACSD	Automatic Cold Start Device
A.D.D.	Automatic Disconnecting Differential
A/F	Air-Fuel Ratio
AHC	Active Height Control Suspension
ALR	Automatic Locking Retractor
ALT	Alternator
AMP	Amplifier
ANT	Antenna
APPROX.	Approximately
ASSY	Assembly
A/T	Automatic Transmission (Transaxle)
ATF	Automatic Transmission Fluid
AUTO	Automatic
AUX	Auxiliary
AVG	Average
AVS	Adaptive Variable Suspension
B+	Battery Voltage
BACS	Boost Altitude Compensation System
BAT	Battery
BDC	Bottom Dead Center
B/L	Bi-Level
B/S	Bore-Stroke Ratio
BTDC	Before Top Dead Center
BVSV	Bimetallic Vacuum Switching Valve
CB	Circuit Breaker
CCo	Catalytic Converter For Oxidation
CD	Compact Disc
CF	Cornering Force
CG	Center Of Gravity
CH	Channel
CKD	Complete Knock Down
COMB.	Combination
CPE	Coupe
CPS	Combustion Pressure Sensor
CPU	Central Processing Unit
CRS	Child Restraint System
CTR	Center
C/V	Check Valve
CV	Control Valve
CW	Curb Weight
DC	Direct Current
DEF	Defogger
DFL	Deflector

Abbreviations	Meaning
DIFF.	Differential
DIFF. LOCK	Differential Lock
D/INJ	Direct Injection
DLC	Data Link Connector
DLI	Distributorless Ignition
DOHC	Double Overhead Cam
DP	Dash Pot
DS	Dead Soak
DSP	Digital Signal Processor
DTC	Diagnostic Trouble Code
ECAM	Engine Control And Measurement System
ECD	Electronic Controlled Diesel
ECDY	Eddy Current Dynamometer
ECT	Electronic Control Transmission
ECU	Electronic Control Unit
ED	Electro-Deposited Coating
EDU	Electronic Driving Unit
EDIC	Electric Diesel Injection Control
EFI	Electronic Fuel Injection
E/G	Engine
EGR	Exhaust Gas Recirculation
EGR-VM	EGR-Vacuum Modulator
ELR	Emergency Locking Retractor
ENG	Engine
ESA	Electronic Spark Advance
ETCS	Electronic Throttle Control System
EVAP	Evaporative Emission Control
EVP	Evaporator
E-VRV	Electric Vacuum Regulating Valve
EX	Exhaust
FE	Fuel Economy
FF	Front-Engine Front-Wheel-Drive
F/G	Fuel Gauge
FIPG	Formed In Place Gasket
FL	Fusible Link
F/P	Fuel Pump
FPU	Fuel Pressure Up
FR	Front
F/W	Flywheel
FW/D	Flywheel Damper
FWD	Front-Wheel-Drive
GAS	Gasoline
GND	Ground
HAC	High Altitude Compensator
H/B	Hatchback
H-FUSE	High Current Fuse
HI	High
HID	High Intensity Discharge (Head Lamp)
HSG	Housing
HT	Hard Top
HWS	Heated Windshield System

Abbreviations	Meaning
IC	Integrated Circuit
IDI	Indirect Diesel Injection
IFS	Independent Front Suspension
IG	Ignition
IIA	Integrated Ignition Assembly
IN	Intake (Manifold, Valve)
INT	Intermittent
I/P	Instrument Panel
IRS	Independent Rear Suspension
ISC	Idle Speed Control
J/B	Junction Block
J/C	Junction Connector
KD	Kick-Down
LAN	Local Area Network
LB	Liftback
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LH	Left-Hand
LHD	Left-Hand Drive
L/H/W	Length, Height, Width
LLC	Long-Life Coolant
LNG	Liquified Natural Gas
LO	Low
LPG	Liquified Petroleum Gas
LSD	Limited Slip Differential
LSP & PV	Load Sensing Proportioning And Bypass Valve
LSPV	Load Sensing Proportioning Valve
MAP	Manifold Absolute Pressure
MAX.	Maximum
MIC	Microphone
MIL	Malfunction Indicator Lamp
MIN.	Minimum
MP	Multipurpose
MPI	Multipoint Electronic Injection
MPX	Multiplex Communication System
M/T	Manual Transmission
MT	Mount
MTG	Mounting
N	Neutral
NA	Natural Aspiration
NO.	Number
O2S	Oxygen Sensor
O/D	Overdrive
OEM	Original Equipment Manufacturing
OHC	Overhead Camshaft
OHV	Overhead Valve
OPT	Option
O/S	Oversize
P & BV	Proportioning And Bypass Valve
PCS	Power Control System
PCV	Positive Crankcase Ventilation

Abbreviations	Meaning
PKB	Parking Brake
PPS	Progressive Power Steering
PS	Power Steering
PTO	Power Take-Off
P/W	Power Window
R & P	Rack And Pinion
R/B	Relay Block
RBS	Recirculating Ball Type Steering
R/F	Reinforcement
RFS	Rigid Front Suspension
RRS	Rigid Rear Suspension
RH	Right-Hand
RHD	Right-Hand Drive
RLY	Relay
ROM	Read Only Memory
RR	Rear
RRS	Rear-Wheel Drive
RWD	Rear-Wheel Drive
SDN	Sedan
SEN	Sensor
SICS	Starting Injection Control System
SOC	State Of Charge
SOHC	Single Overhead Camshaft
SPEC	Specification
SPI	Single Point Injection
SRS	Supplemental Restraint System
SSM	Special Service Materials
SST	Special Service Tools
STD	Standard
STJ	Cold-Start Fuel Injection
SW	Switch
SYS	System
T/A	Transaxle
TACH	Tachometer
TBI	Throttle Body Electronic Fuel Injection
TC	Turbocharger
TCCS	TOYOTA Computer-Controlled System
TCV	Timing Control Valve
TDC	Top Dead Center
TEMP.	Temperature
TEMS	TOYOTA Electronic Modulated Suspension
TFT	Toyota Free-Tronic
TIS	Total Information System For Vehicle Development
T/M	Transmission
TMC	TOYOTA Motor Corporation
TMMK	TOYOTA Motor Manufacturing Kentucky, Inc.
TRC	Traction Control System
TURBO	Turbocharge
TWC	Three-Way Catalyst
U/D	Underdrive
U/S	Undersize

Abbreviations	Meaning
VCV	Vacuum Control Valve
VENT	Ventilator
VIN	Vehicle Identification Number
VPS	Variable Power Steering
VSC	Vehicle Skid Control
VSV	Vacuum Switching Valve
VTV	Vacuum Transmitting Valve
VVT-I	Variable Valve Timing-intelligent
W/	With
WGN	Wagon
W/H	Wire Harness
W/O	Without
1ST	First
2ND	Second
2WD	Two Wheel Drive Vehicle (4 x 2)
3RD	Third
4TH	Fourth
4WD	Four Wheel Drive Vehicle (4 x 4)
4WS	Four Wheel Steering System
5TH	Fifth

GLOSSARY OF SAE AND TOYOTA TERMS

This glossary lists all SAE-J1930 terms and abbreviations used in this manual in compliance with SAE recommendations, as well as their TOYOTA equivalents.

SAE ABBREVIATIONS	SAE TERMS	TOYOTA TERMS ()—ABBREVIATIONS
A/C	Air Conditioning	Air Conditioner
ACL	Air Cleaner	Air Cleaner, A/CL
AIR	Secondary Air Injection	Air Injection (AI)
AP	Accelerator Pedal	—
B+	Battery Positive Voltage	+B, Battery Voltage
BARO	Barometric Pressure	HAC
CAC	Charge Air Cooler	Intercooler
CARB	Carburetor	Carburetor
CFI	Continuous Fuel Injection	—
CKP	Crankshaft Position	Crank Angle
CL	Closed Loop	Closed Loop
CMP	Camshaft Position	Cam Angle
CPP	Clutch Pedal Position	—
CTOX	Continuous Trap Oxidizer	—
CTP	Closed Throttle Position	LL ON, Idle ON
DFI	Direct Fuel Injection (Diesel)	Direct Injection (DI)
DI	Distributor Ignition	—
DLC1 DLC2 DLC3	Data Link Connector 1 Data Link Connector 2 Data Link Connector 3	1: Check Connector 2: Total Diagnosis Communication Link (TDCL) 3: OBD II Diagnostic Connector
DTC	Diagnostic Trouble Code	Diagnostic Code
DTM	Diagnostic Test Mode	—
ECL	Engine Control Level	—
ECM	Engine Control Module	Engine ECU (Electronic Control Unit)
ECT	Engine Coolant Temperature	Coolant Temperature, Water Temperature (THW)
EEPROM	Electrically Erasable Programmable Read Only Memory	Electrically Erasable Programmable Read Only Memory (EEPROM), Erasable Programmable Read Only Memory (EPROM)
EFE	Early Fuel Evaporation	Cold Mixture Heater (CMH), Heat Control Valve (HCV)
EGR	Exhaust Gas Recirculation	Exhaust Gas Recirculation (EGR)
EI	Electronic Ignition	TOYOTA Distributorless Ignition (TDI)
EM	Engine Modification	Engine Modification (EM)
EPROM	Erasable Programmable Read Only Memory	Programmable Read Only Memory (PROM)
EVAP	Evaporative Emission	Evaporative Emission Control (EVAP)
FC	Fan Control	—
FEEPROM	Flash Electrically Erasable Programmable Read Only Memory	—
FEPRM	Flash Erasable Programmable Read Only Memory	—
FF	Flexible Fuel	—
FP	Fuel Pump	Fuel Pump
GEN	Generator	Alternator
GND	Ground	Ground (GND)

HO2S	Heated Oxygen Sensor	Heated Oxygen Sensor (HO ₂ S)
IAC	Idle Air Control	Idle Speed Control (ISC)
IAT	Intake Air Temperature	Intake or Inlet Air Temperature
ICM	Ignition Control Module	-
IFI	Indirect Fuel Injection	Indirect Injection (IDL)
IFS	Inertia Fuel-Shutoff	-
ISC	Idle Speed Control	-
KS	Knock Sensor	Knock Sensor
MAF	Mass Air Flow	Air Flow Meter
MAP	Manifold Absolute Pressure	Manifold Pressure Intake Vacuum
MC	Mixture Control	Electric Bleed Air Control Valve (EBCV) Mixture Control Valve (MCV) Electric Air Control Valve (EACV)
MDP	Manifold Differential Pressure	-
MFI	Multiport Fuel Injection	Electronic Fuel Injection (EFI)
MIL	Malfunction Indicator Lamp	Check Engine Lamp
MST	Manifold Surface Temperature	-
MVZ	Manifold Vacuum Zone	-
NVRAM	Non-Volatile Random Access Memory	-
O2S	Oxygen Sensor	Oxygen Sensor, O ₂ Sensor (O ₂ S)
OBD	On-Board Diagnostic	On-Board Diagnostic System (OBD)
OC	Oxidation Catalytic Converter	Oxidation Catalyst Convert (OC), CCo
OP	Open Loop	Open Loop
PAIR	Pulsed Secondary Air Injection	Air Suction (AS)
PCM	Powertrain Control Module	-
PNP	Park/Neutral Position	-
PROM	Programmable Read Only Memory	-
PSP	Power Steering Pressure	-
PTOX	Periodic Trap Oxidizer	Diesel Particulate Filter (DPF) Diesel Particulate Trap (DPT)
RAM	Random Access Memory	Random Access Memory (RAM)
RM	Relay Module	-
ROM	Read Only Memory	Read Only Memory (ROM)
RPM	Engine Speed	Engine Speed
SC	Supercharger	Supercharger
SCB	Supercharger Bypass	E-ABV
SFI	Sequential Multiport Fuel Injection	Electronic Fuel Injection (EFI), Sequential Injection
SPL	Smoke Puff Limiter	-
SRI	Service Reminder Indicator	-
SRT	System Readiness Test	-
ST	Scan Tool	-
TB	Throttle Body	Throttle Body
TBI	Throttle Body Fuel Injection	Single Point Injection Central Fuel Injection (CI)
TC	Turbocharger	Turbocharger
TCC	Torque Converter Clutch	Torque Converter

TCM	Transmission Control Module	Transmission ECU, ECT ECU
TP	Throttle Position	Throttle Position
TR	Transmission Range	-
TVV	Thermal Vacuum Valve	Bimetallic Vacuum Switching Valve (BVSV) Thermostatic Vacuum Switching Valve (TVSV)
TWC	Three-Way Catalytic Converter	Three-Way Catalytic (TWC) Manifold Converter CC_{CO}
TWC+OC	Three-Way + Oxidation Catalytic Converter	$CC_R + CC_O$
VAF	Volume Air Flow	Air Flow Meter
VR	Voltage Regulator	Voltage Regulator
VSS	Vehicle Speed Sensor	Vehicle Speed Sensor
WOT	Wide Open Throttle	Full Throttle
WU-OC	Warm Up Oxidation Catalytic Converter	-
WU-TWC	Warm Up Three-Way Catalytic Converter	-
3GR	Third Gear	-
4GR	Fourth Gear	-

TORQUE SPECIFICATION

Part Tightened	N·m	kgf·cm	ft·lbf
Nozzle retaining nut x Injection nozzle holder	47	475	34
Snubber valve x Injection pump body	59	600	43
Distributive head plug x Injection pump body	88	900	65
Fuel temperature sensor x Injection pump body	22	220	16
Fuel inlet hollow screw x Injection pump body	37	375	27
Fuel filter to injection pump fuel pipe x Fuel inlet hollow screw	27	271	20
Overflow screw x Injection pump body	27	271	20

ENGINE MECHANICAL

T04E-W

SERVICE DATA

Idler tension spring Free length Installed tension		44.4 – 45.4 mm (1.748 – 1.787 in.) 53 – 59 N (5.42 – 5.98 kgf, 11.9 – 13.2 lbf) at 52.1 mm (2.051 in.)
Cylinder head set bolt Outer diameter	Standard Minimum	11.80 – 12.00 mm (0.4646 – 0.4724 in.) 11.60 mm (0.4567 in.)
Cylinder head gasket New installed cylinder head gasket thickness	Mark B D F	1.40 – 1.50 mm (0.0551 – 0.0591 in.) 1.50 – 1.60 mm (0.0591 – 0.0630 in.) 1.60 – 1.70 mm (0.0630 – 0.0669 in.)
Valve clearance at cold	Intake Exhaust	0.20 – 0.30 mm (0.008 – 0.012 in.) 0.40 – 0.50 mm (0.016 – 0.020 in.)
Cylinder head Warpage	Maximum	0.20 mm (0.0079 in.)
Intake Valve Valve stem diameter Valve face angle Margin thickness Overall length	Standard Minimum Standard Minimum	7.975 – 7.990 mm (0.3140 – 0.3146 in.) 44.5° 1.6 mm (0.063 in.) 1.1 mm (0.043 in.) 104.10 – 104.50 mm (4.0984 – 4.1142 in.) 103.60 mm (4.0787 in.)
Exhaust Valve Valve stem diameter Valve face angle Margin thickness Overall length	Standard Minimum Standard Minimum	7.960 – 7.975 mm (0.3134 – 0.3140 in.) 44.5° 1.7 mm (0.067 in.) 1.2 mm (0.047 in.) 103.95 – 104.35 mm (4.0925 – 4.1083 in.) 103.45 mm (4.0728 in.)
Inner compression spring Deviation Free length Installed tension	Maximum Type A B	2.0 mm (0.079 in.) 46.20 mm (1.8189 in.) 48.54 mm (1.9110 in.) 301 – 322 N (30.7 – 33.9 kgf, 67.7 – 74.7 lbf) at 37.0 mm (1.457 in.)
Intake valve guide bush Inside diameter Oil clearance Bush bore diameter Protrusion height	Standard Maximum STD O/S 0.05	8.010 – 8.030 mm (0.3154 – 0.3161 in.) 0.020 – 0.055 mm (0.0008 – 0.0022 in.) 0.08 mm (0.0031 in.) 13.004 – 13.025 mm (0.5120 – 0.5128 in.) 13.054 – 13.075 mm (0.5139 – 0.5148 in.) 10.8 – 11.2 mm (0.425 – 0.441 in.)
Exhaust valve guide bush Inside diameter Oil clearance Bush bore diameter Protrusion height	Standard Maximum STD O/S 0.05	8.010 – 8.030 mm (0.3154 – 0.3161 in.) 0.035 – 0.070 mm (0.0014 – 0.0028 in.) 0.10 mm (0.0039 in.) 13.004 – 13.025 mm (0.5120 – 0.5128 in.) 13.054 – 13.075 mm (0.5139 – 0.5148 in.) 10.8 – 11.2 mm (0.425 – 0.441 in.)
Intake valve seats Contacting width		1.5 – 1.9 mm (0.059 – 0.075 in.)
Exhaust valve seats Contacting width		1.8 – 2.2 mm (0.071 – 0.087 in.)
Valve lifter Lifter diameter Lifter bore diameter Oil clearance	Standard Maximum	40.892 – 40.902 mm (1.6099 – 1.6103 in.) 40.960 – 40.980 mm (1.6126 – 1.6134 in.) 0.058 – 0.088 mm (0.0023 – 0.0035 in.) 0.10 mm (0.0039 in.)

3

Camshaft			
Circle runout	Maximum		0.10 mm (0.0039 in.)
Cam lobe height	Standard		
	Intake		54.890 – 54.910 mm (2.1610 – 2.1618 in.)
	Exhaust		54.990 – 55.010 mm (2.1650 – 2.1657 in.)
	Minimum		
	Intake		54.39 mm (2.1413 in.)
	Exhaust		54.49 mm (2.1453 in.)
Journal diameter	STD No.1		34.969 – 34.985 mm (1.3767 – 1.3774 in.)
	Others		27.969 – 27.985 mm (1.1011 – 1.1018 in.)
	U/S 0.125 No.1		34.844 – 34.860 mm (1.3718 – 1.3724 in.)
	Others		27.844 – 27.860 mm (1.0962 – 1.0968 in.)
	U/S 0.250 No.1		34.719 – 34.735 mm (1.3669 – 1.3675 in.)
	Others		27.719 – 27.735 mm (1.0913 – 1.0919 in.)
Oil clearance	Standard		0.022 – 0.074 mm (0.0009 – 0.0029 in.)
	Maximum		0.10 mm (0.0039 in.)
Thrust clearance	Standard		0.080 – 0.280 mm (0.0031 – 0.0110 in.)
	Maximum		0.35 mm (0.0138 in.)
Combustion chamber			
Shim thickness			0.03 mm (0.0012 in.)
Protrusion			Minus 0.03 – Plus 0.03 mm (Minus 0.0012 – Plus 0.0012 in.)
Connecting rod			
Thrust clearance	Standard		0.080 – 0.300 mm (0.0031 – 0.0118 in.)
	Maximum		0.35 mm (0.0138 in.)
Oil clearance	Standard		
	STD		0.036 – 0.064 mm (0.0014 – 0.0025 in.)
	U/S 0.25, U/S 0.50		0.033 – 0.079 mm (0.0013 – 0.0031 in.)
	Maximum		0.10 mm (0.0039 in.)
Connecting rod bearing center wall thickness (Reference)	Standard		
	Mark 1		1.478 – 1.482 mm (0.0582 – 0.0583 in.)
	2		1.482 – 1.486 mm (0.0583 – 0.0585 in.)
	3		1.486 – 1.490 mm (0.0585 – 0.0587 in.)
Rod bent	Maximum per 100 mm (3.94 in.)		0.05 mm (0.0020 in.)
Rod twist	Maximum per 100 mm (3.94 in.)		0.15 mm (0.0059 in.)
Bush inside diameter			29.008 – 29.020 mm (1.1420 – 1.1425 in.)
Connecting rod bolt tension portion diameter	Standard		8.400 – 8.600 mm (0.3307 – 0.3386 in.)
	Minimum		8.20 mm (0.3228 in.)
Crankshaft			
Thrust clearance	Standard		0.040 – 0.250 mm (0.0016 – 0.0098 in.)
	Maximum		0.30 mm (0.0118 in.)
Thrust washer thickness	STD		2.430 – 2.480 mm (0.0957 – 0.0976 in.)
	O/S 0.125		2.493 – 2.543 mm (0.0981 – 0.1001 in.)
	O/S 0.250		2.555 – 2.605 mm (0.1006 – 0.1026 in.)
Main journal oil clearance	Standard		
	STD		0.034 – 0.065 mm (0.0013 – 0.0026 in.)
	U/S 0.25, 0.50		0.033 – 0.079 mm (0.0013 – 0.0031 in.)
	Maximum		0.10 mm (0.0039 in.)
Main bearing center wall thickness (Reference)	Standard		
	Mark 1		1.979 – 1.983 mm (0.0779 – 0.0781 in.)
	2		1.983 – 1.987 mm (0.0781 – 0.0782 in.)
	3		1.987 – 1.991 mm (0.0782 – 0.0784 in.)
Circle runout	Maximum		0.06 mm (0.0024 in.)
Main journal diameter	STD		61.985 – 62.000 mm (2.4403 – 2.4409 in.)
	U/S 0.25		61.745 – 61.755 mm (2.4309 – 2.4413 in.)
	U/S 0.50		61.495 – 61.505 mm (2.4211 – 2.4215 in.)
Crank pin diameter	STD		54.988 – 55.000 mm (2.1649 – 2.1654 in.)
	U/S 0.25		54.745 – 54.755 mm (2.1553 – 2.1557 in.)
	U/S 0.50		54.495 – 54.505 mm (2.1455 – 2.1459 in.)
Main journal taper and out-of-round	Maximum		0.02 mm (0.0008 in.)
Crank pin taper and out-of-round	Maximum		0.02 mm (0.0008 in.)

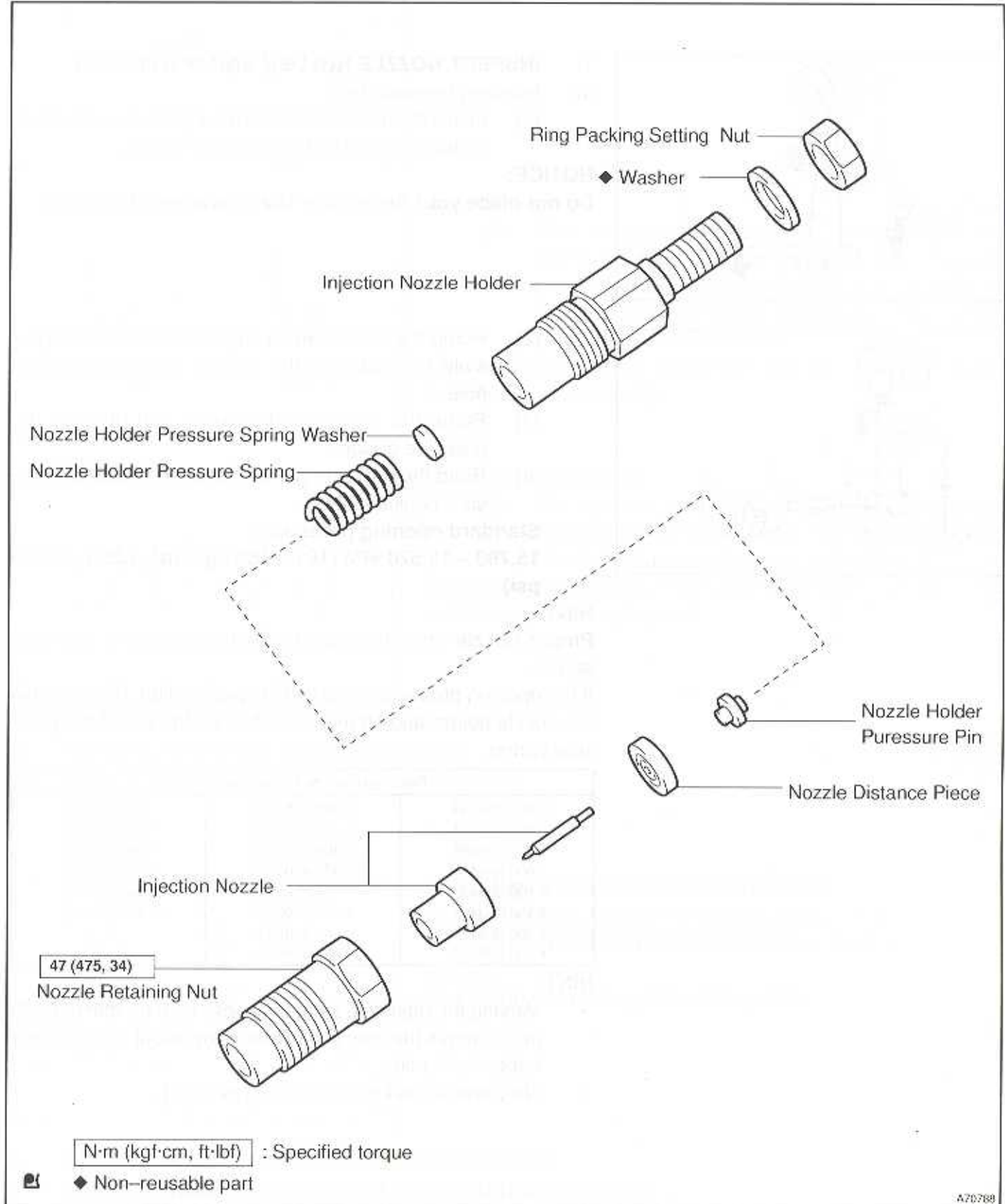
Cylinder block Warpage Cylinder bore diameter	Maximum Standard Mark 1 2 3 Maximum STD O/S 0.50	0.20 mm (0.0079 in.) 99.500 – 99.510 mm (3.9173 – 3.9177 in.) 99.510 – 99.520 mm (3.9177 – 3.9181 in.) 99.520 – 99.530 mm (3.9181 – 3.9185 in.) 99.73 mm (3.9264 in.) 100.23 mm (3.9461 in.)
Piston Piston diameter Oil clearance Piston protrusion from cylinder block	STD Mark 1 2 3 O/S 0.50 Standard Maximum	99.450 – 99.460 mm (3.9153 – 3.9157 in.) 99.460 – 99.470 mm (3.9157 – 3.9161 in.) 99.470 – 99.480 mm (3.9161 – 3.9165 in.) 99.950 – 99.980 mm (3.9350 – 3.9362 in.) 0.040 – 0.060 mm (0.0016 – 0.0024 in.) 0.13 mm (0.0051 in.) 0.68 – 0.97 mm (0.0268 – 0.0382 in.)
Piston pin Diameter Piston pin oil clearance	Standard Maximum	29.000 – 29.012 mm (1.1417 – 1.1422 in.) 0.004 – 0.012 mm (0.0002 – 0.0005 in.) 0.05 mm (0.0020 in.)
Piston ring set Piston ring groove clearance Piston ring end gap	Standard No.1 No.2 Oil Maximum Standard No.1 No.2 Oil Maximum No.1 No.2 Oil	0.057 – 0.101 mm (0.0022 – 0.0040 in.) 0.060 – 0.100 mm (0.0024 – 0.0039 in.) 0.030 – 0.070 mm (0.0012 – 0.0028 in.) 0.20 mm (0.0079 in.) 0.350 – 0.590 mm (0.0138 – 0.0232 in.) 0.470 – 0.720 mm (0.0185 – 0.0283 in.) 0.200 – 0.520 mm (0.0079 – 0.0205 in.) 1.29 mm (0.0508 in.) 1.42 mm (0.0559 in.) 1.22 mm (0.0480 in.)

TORQUE SPECIFICATION

Part tightened		N·m	kgf·cm	ft·lbf
Engine rear oil seal retainer x Cylinder block		13	130	10
Timing gear case x Cylinder block		23	230	17
Oil strainer x Cylinder block		18	180	13
Oil strainer x Timing gear case		21	210	15
Oil pan x Cylinder block		18	180	13
Oil pan x Timing gear case		18	180	13
Oil pan x Engine rear oil seal retainer		18	180	13
Water pump x Timing gear case		23	230	17
Timing belt idler No. 2 x Timing gear case		33	340	24
Timing belt idler No. 1 x Timing gear case	12 mm head	19	195	14
Cylinder head x Cylinder block	1st	78	800	58
	2nd	Turn 90°	Turn 90°	Turn 90°
	3rd	Turn 90°	Turn 90°	Turn 90°
Camshaft bearing cap x Cylinder head		25	255	18
Camshaft oil seal retainer x Cylinder head		18	185	13
Timing belt No. 2 cover x Cylinder head		18	185	13
Camshaft timing pulley x Camshaft		98	1,000	72
Cylinder head cover x Cylinder head		12	120	9
Taper screw plug No. 1 x Cylinder block		20	200	14
Water drain cock x Cylinder block		49	500	36
Cylinder block oil orifice x Cylinder block		11	110	8
Oil nozzle x Cylinder block		26	260	18
Crankshaft bearing cap x Cylinder block		105	1,050	77
Connecting rod cap x Connecting rod	1st	54	550	40
	2nd	Turn 90°	Turn 90°	Turn 90°

INJECTION NOZZLE SUB-ASSY (5L-E) COMPONENTS

116-3-01

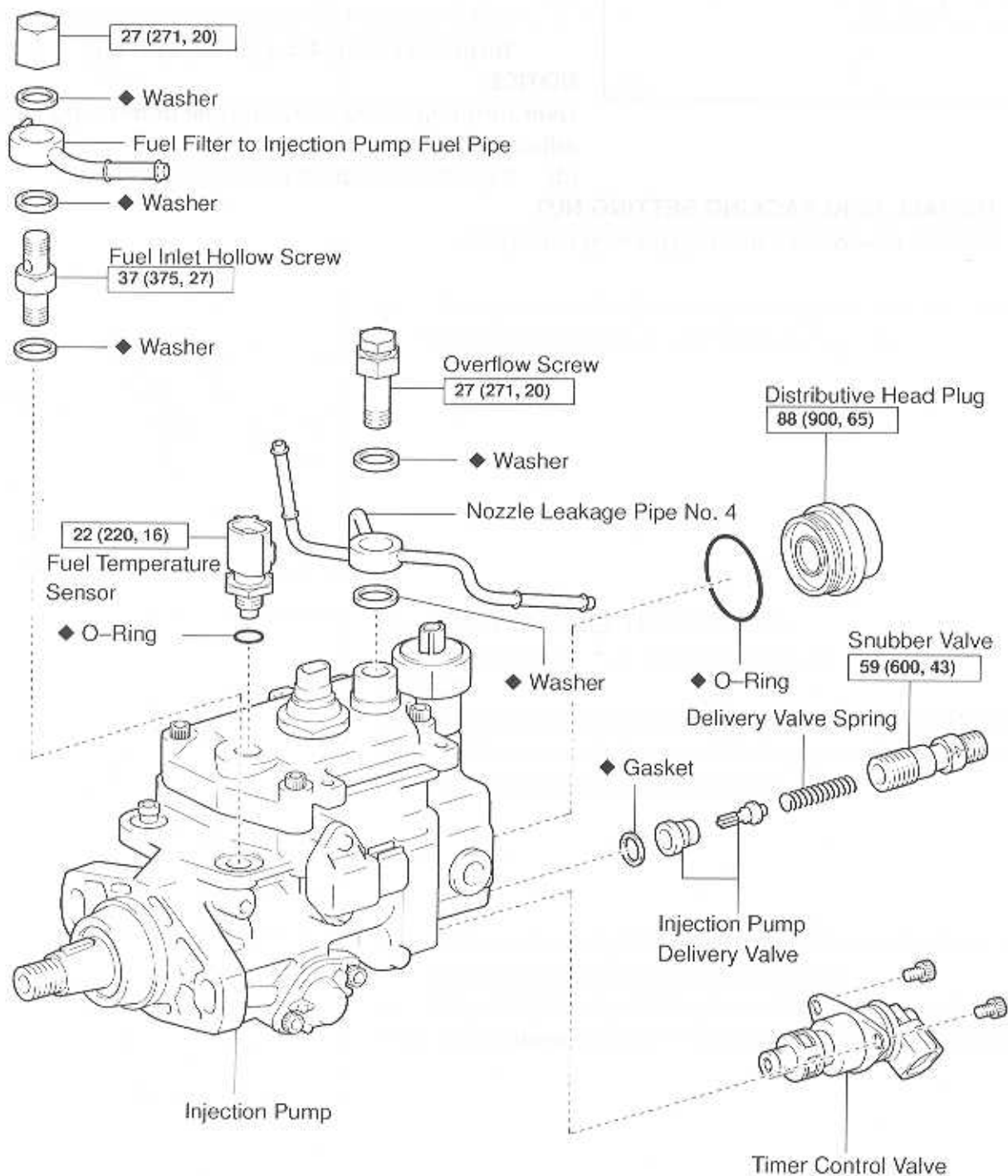


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INJECTION PUMP ASSY (5L-E)

COMPONENTS

F31A-01



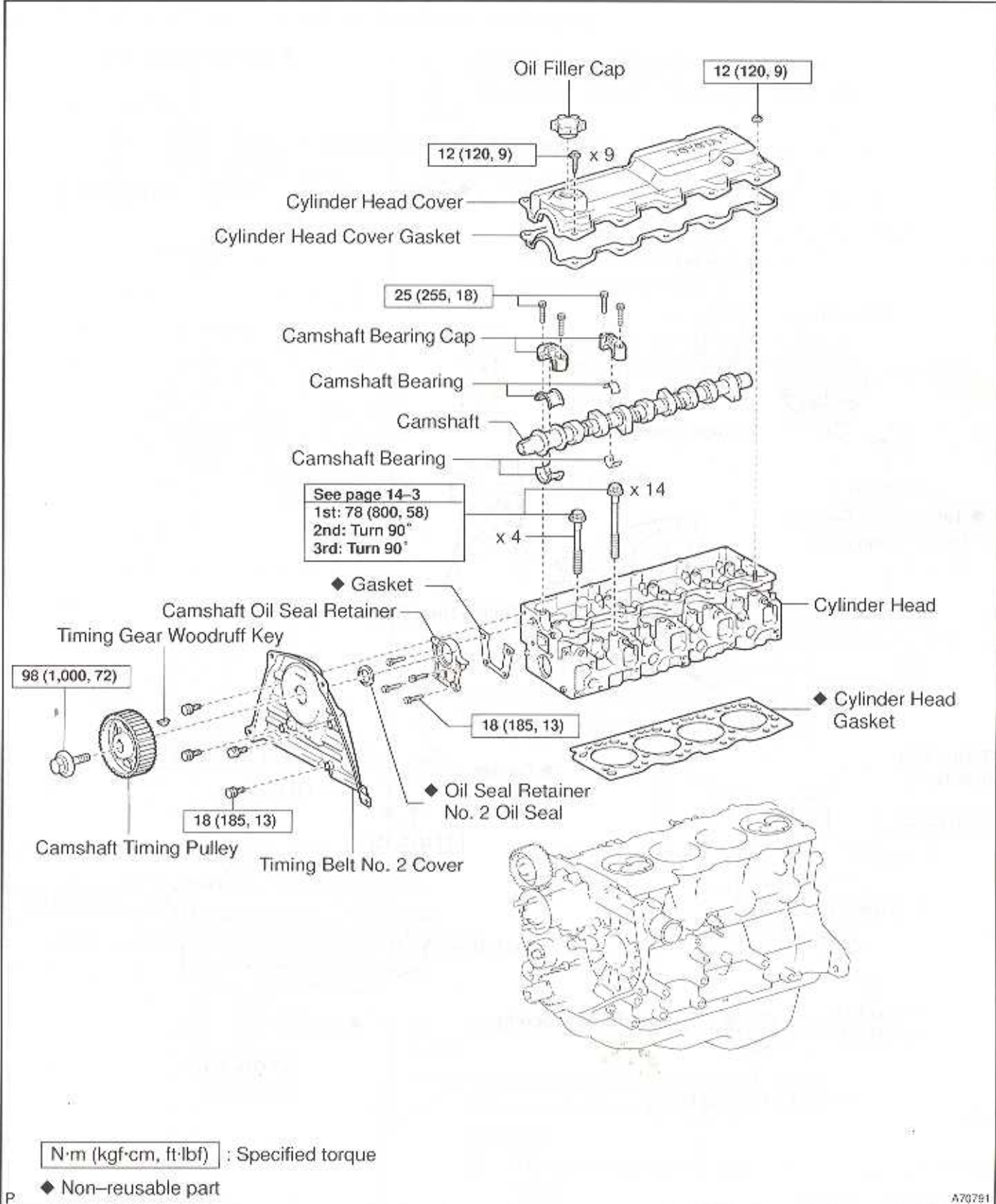
N·m (kgf·cm, ft·lbf) : Specified torque

◆ Non-reusable part

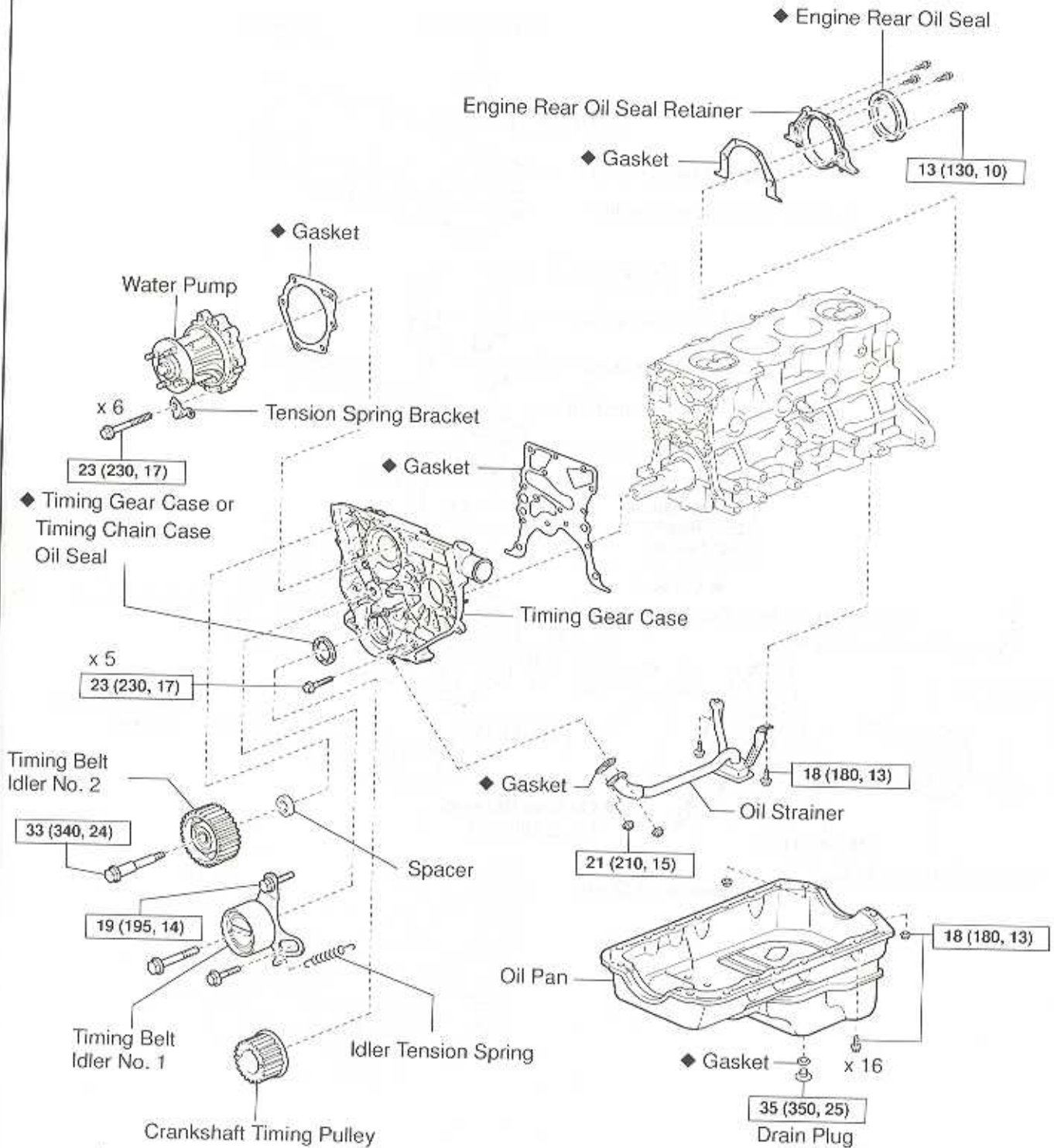
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PARTIAL ENGINE ASSY (5L-E) COMPONENTS

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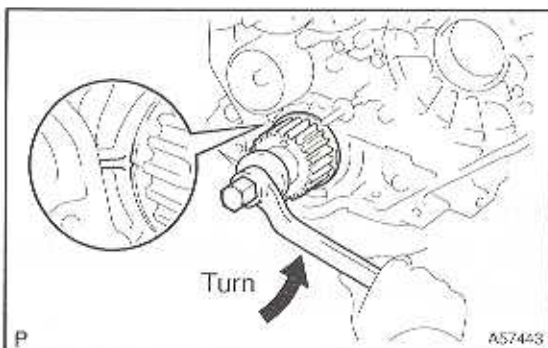


N·m (kgf·cm, ft·lbf) : Specified torque

◆ Non-reusable part

OVERHAUL

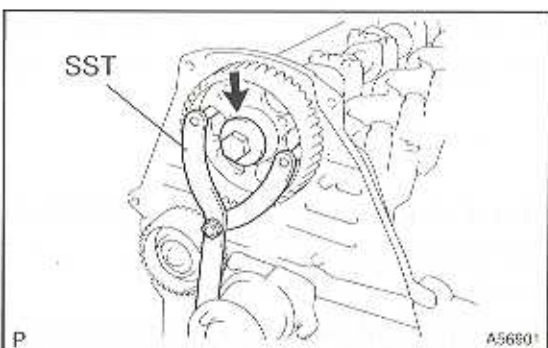
1. REMOVE OIL FILLER CAP SUB-ASSY
2. REMOVE CYLINDER HEAD COVER SUB-ASSY
 - (a) Remove the 9 bolts, nut, cylinder head cover and gasket.

**3. REMOVE CAMSHAFT TIMING PULLEY**

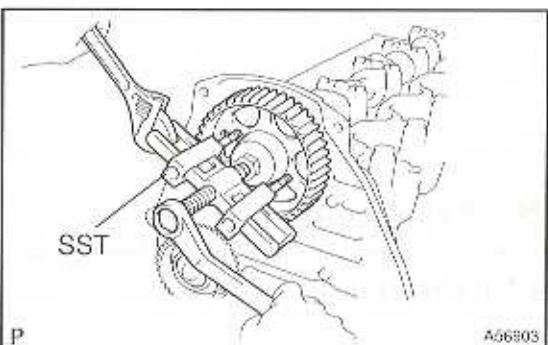
- (a) Set the No. 1 cylinder to approx. 90° BTDC/compression.
- HINT:**

Set the No.1 cylinder to 90° BTDC/compression to avoid interference with the piston top and valve head.

- (1) Using the crankshaft pulley bolt, turn the crankshaft 90° counterclockwise, and put the timing mark of the crankshaft timing pulley with the protrusion of the timing belt case.

14

- (b) Using SST, loosen the pulley bolt.
SST 09960-10010 (09962-01000, 09963-01000)



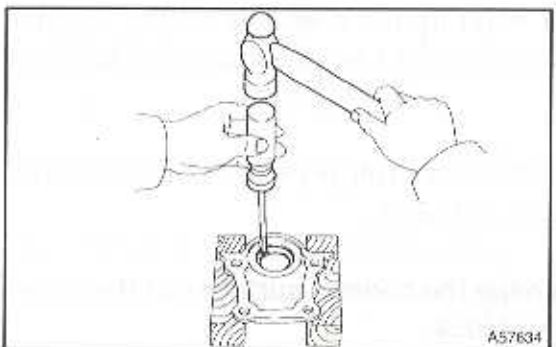
- (c) Using SST, separate the timing pulley from the camshaft.
SST 09950-50013 (09951-05010, 09952-05010, 09953-05010, 09954-05021)
- (d) Remove the pulley bolt and timing pulley.
- (e) Remove the timing gear woodruff key.

4. REMOVE TIMING BELT NO.2 COVER

- (a) Remove the 4 bolts and timing belt cover.

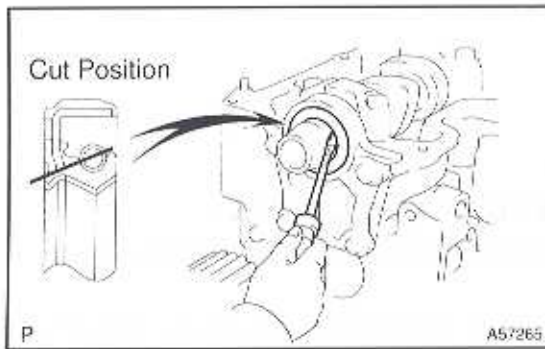
5. REMOVE CAMSHAFT OIL SEAL RETAINER

- (a) Remove the 4 bolts, retainer and gasket.

**6. REMOVE OIL SEAL RETAINER, NO.2 OIL SEAL****HINT:**

There are 2 methods ((a) and (b)) to remove the oil seal.

- (a) If the camshaft oil seal retainer is removed from the cylinder head:
 - (1) Using a screwdriver and hammer, tap out the oil seal.

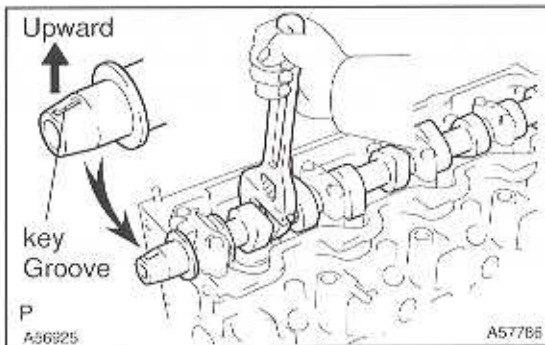


(b) If the camshaft oil seal retainer is installed to the cylinder head:

- (1) Using a knife, cut off the oil seal lip.
- (2) Using a screwdriver, pry out the oil seal.

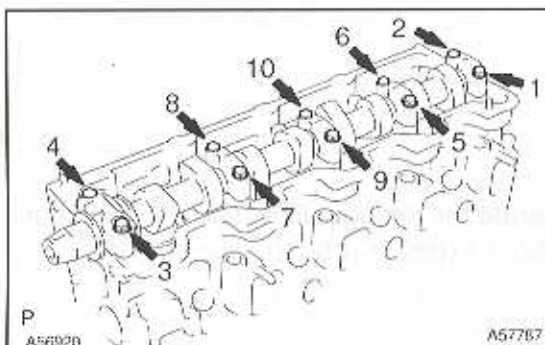
NOTICE:

Be careful not to damage the camshaft. Tape the screwdriver tip.



7. REMOVE CAMSHAFT

(a) Set the key groove of the camshaft, facing upward by turning the camshaft with a wrench.



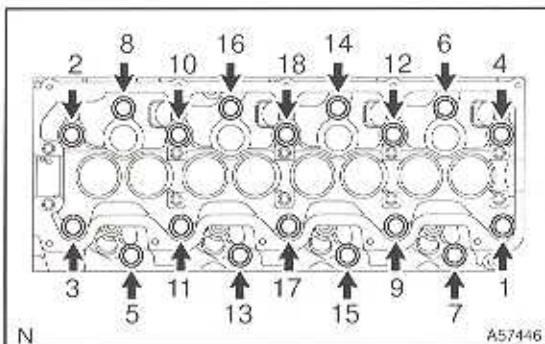
(b) Uniformly loosen and remove the 10 bearing cap bolts, in several passes, in the sequence shown.

(c) Remove the 5 bearing caps and camshaft.

(d) Remove the 10 bearings from the bearing caps and cylinder head.

HINT:

Arrange the bearings in correct order.

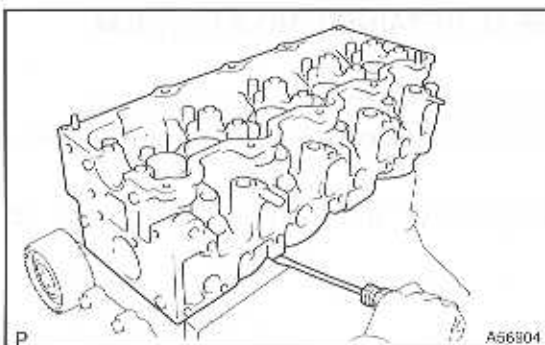


8. REMOVE CYLINDER HEAD SUB-ASSY

(a) Uniformly loosen and remove the 18 cylinder head bolts, in several passes, in the sequence shown.

NOTICE:

Head warpage or cracking could result from removing bolts in incorrect order.



(b) Lift the cylinder head from the dowels on the cylinder block, and place the cylinder head on wooden blocks on a bench.

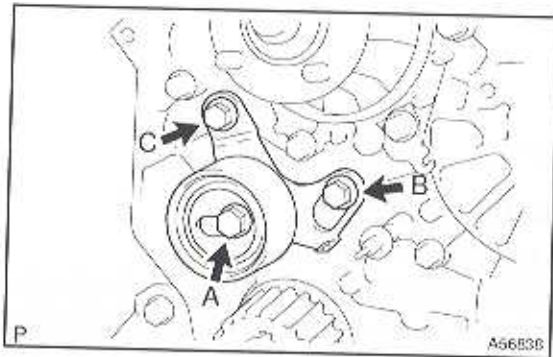
HINT:

If the cylinder head is difficult to lift off, pry with a screwdriver between the cylinder head and block.

NOTICE:

Be careful not to damage the contact surfaces of the cylinder head and cylinder block.

9. REMOVE CYLINDER HEAD GASKET

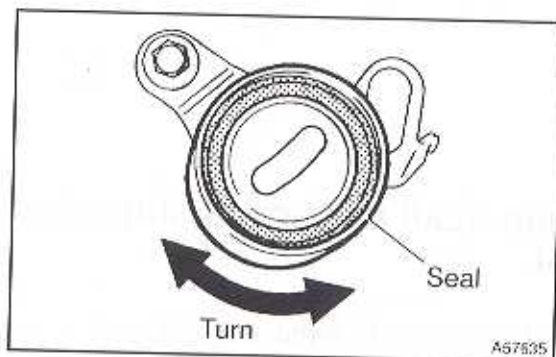


10. REMOVE TIMING BELT IDLER SUB-ASSY NO.1

- Remove the 2 bolts (A and B).
- Loosen the bolt (C), and remove the timing belt idler No.1.

11. REMOVE TIMING BELT IDLER SUB-ASSY NO.2

- Remove the bolt, timing belt idler No.2 and spacer.



12. INSPECT TIMING BELT IDLER SUB-ASSY NO.1

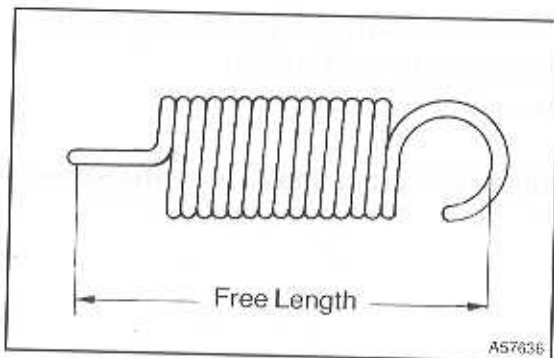
- Visually check the seal portion of the timing belt idler No.1 for oil leakage.

If leakage is found, replace the timing belt idler No.1.

- Check that the timing belt idler No.1 turns smoothly. If necessary, replace the timing belt idler No.1.

13. INSPECT TIMING BELT IDLER SUB-ASSY NO.2

- Check that the timing belt idler No.2 turns smoothly. If necessary, replace the timing belt idler No.2.



14. INSPECT IDLER TENSION SPRING

- Measure the free length of tension spring.

Free length: 44.4 – 45.4 mm (1.748 – 1.787 in.)

If the free length is not as specified, replace the tension spring.

- Measure the tension of the tension spring at the specified installed length.

Installed tension:

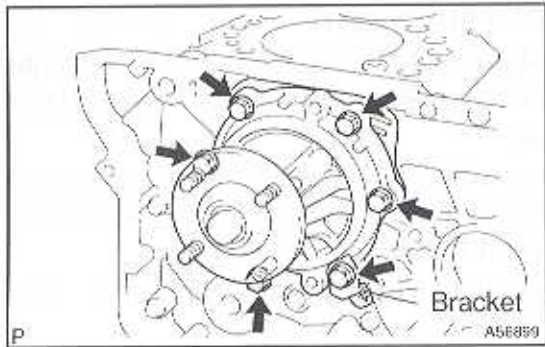
53 – 59 N (5.42 – 5.98 kgf, 11.9 – 13.2 lbf)

at 52.1 mm (2.051 in.)

If the installed tension is not as specified, replace the tension spring.

15. REMOVE WATER PUMP ASSY

- Remove the 6 bolts, tension spring bracket, water pump and gasket.

**31. INSTALL WATER PUMP ASSY**

- (a) Install a new gasket, the water pump and tension spring bracket with the 6 bolts.

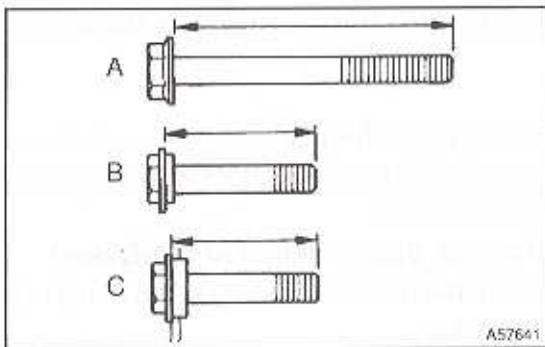
Torque: 23 N-m (230 kgf-cm, 17 ft-lbf)

32. INSTALL TIMING BELT IDLER SUB-ASSY NO.2

- (a) Install the spacer and timing belt idler No.2 with the bolt.

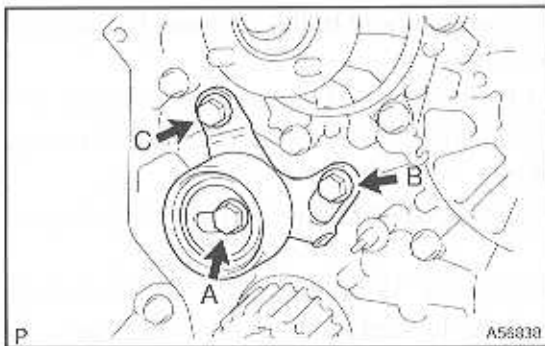
Torque: 33 N-m (340 kgf-cm, 24 ft-lbf)

- (b) Check that the timing belt idler No.2 moves smoothly.

**33. INSTALL TIMING BELT IDLER SUB-ASSY NO.1**

HINT:

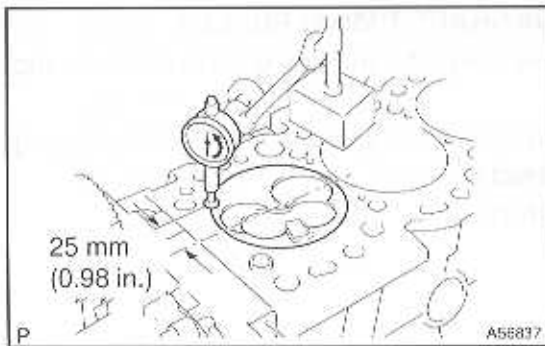
- The bolt lengths for bolt types A, B and C shown in the illustration are:
 - A: 76.5 mm (3.012 in.)
 - B: 42.9 mm (1.689 in.), Color: Yellow
 - C: 41.3 mm (1.626 in.), Color: Silver
- Bolt C is combined with the timing belt idler No.1.



- (a) Install the timing belt idler No.1 with the 3 bolts.

- (b) Tighten the bolt (C).

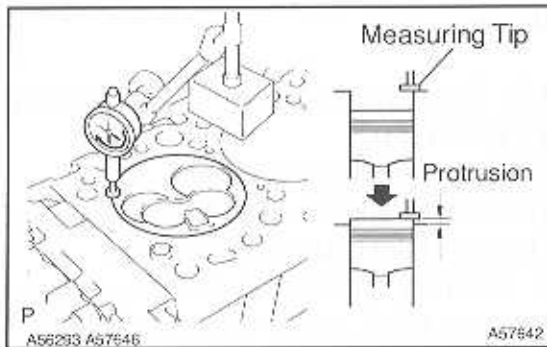
Torque: 19 N-m (195 kgf-cm, 14 ft-lbf)

**34. INSTALL CYLINDER HEAD GASKET**

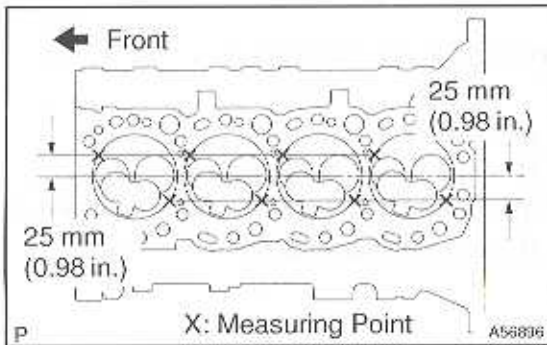
- (a) Check the piston protrusions for each cylinder
- Clean the cylinder block with solvent.
 - Set the piston of the cylinder to be measured to slightly before TDC.
 - Place a dial indicator on the cylinder block, set the measuring tip as shown in the illustration.
 - Set the dial indicator at 0 mm (0 in.).

HINT:

- Use a dial indicator measuring tip as shown in the illustration.
- Make sure that the measuring tip is square to the cylinder block gasket surface and piston head when taking the measurements.



- (5) Find where the piston head protrudes most by slowly turning the crankshaft clockwise and counter-clockwise.



- (6) Measure each cylinder at 2 places as shown in the illustration, making a total of 8 measurements.
 (7) For the piston protrusion value of each cylinder, use the average of the 2 measurements of each cylinder.

Piston protrusion: 0.68 – 0.97 mm (0.0268 – 0.0382 in.)

HINT:

When removing piston and connecting rod assembly:

If the protrusion is not as specified, remove the piston and connecting rod assembly and reinstall it (See page 14-38).

- (b) Select a new cylinder head gasket.

HINT:

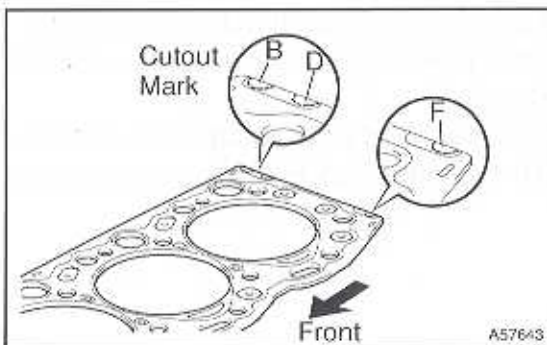
There are 3 sizes of new cylinder head gaskets, marked B, D or F accordingly.

New installed cylinder head gasket thickness:

B	1.40 – 1.50 mm (0.0551 – 0.0591 in.)
D	1.50 – 1.60 mm (0.0591 – 0.0630 in.)
F	1.60 – 1.70 mm (0.0630 – 0.0669 in.)

- (1) Select the largest piston protrusion value from the measurements made, then select a new appropriate gasket according to the table below.

Piston protrusion	Gasket size
0.68 – 0.77 mm (0.0268 – 0.0303 in.)	Use B
0.78 – 0.87 mm (0.0307 – 0.0343 in.)	Use D
0.88 – 0.97 mm (0.0346 – 0.0382 in.)	Use F



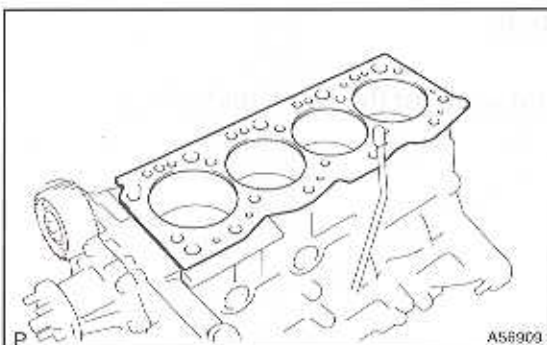
- (c) Place a new cylinder head gasket in position on the cylinder block.

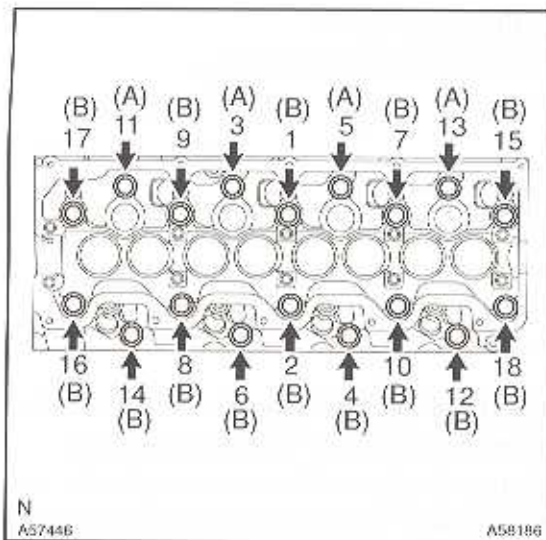
NOTICE:

Be careful of the installation direction.

35. INSTALL CYLINDER HEAD SUB-ASSY

- (a) Place the cylinder head in position on the cylinder head gasket.





(b) Install the cylinder head bolts.

HINT:

- The cylinder head bolts are tightened in 3 progressive steps (steps (2), (4) and (5)).
 - If any bolts is broken or deformed, replace it.
- (1) Apply a light coat of engine oil on the threads and under the heads of the cylinder head bolts.
 - (2) Install and uniformly tighten the 18 cylinder head bolts, in several passes, in the sequence shown.

Torque: 78 N·m (800 kgf·cm, 58 ft·lbf)

HINT:

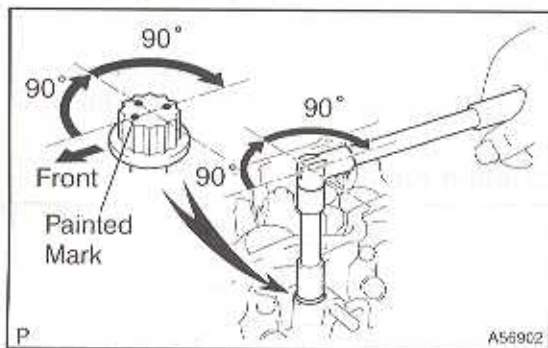
Each bolt length is indicated in the illustration.

Bolt length:

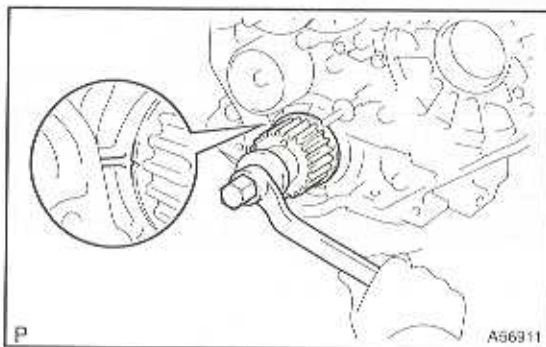
107 mm (4.12 in.) for A

127 mm (5.00 in.) for B

If any one of the cylinder head bolts does not meet the torque specification, replace the cylinder head bolt.



- (3) Mark the front of the cylinder head bolt with paint.
- (4) Retighten the cylinder head bolts 90° in the numerical order shown.
- (5) Retighten cylinder head bolts by an additional 90°.
- (6) Check that the painted mark is now facing rearward.



36. INSTALL CAMSHAFT

(a) Set the No. 1 cylinder to 90° BTDC/compression.

HINT:

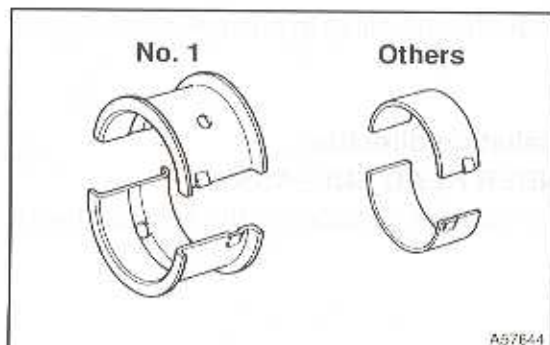
Set the No. 1 cylinder to 90° BTDC/compression to avoid interference with the piston top and valve head.

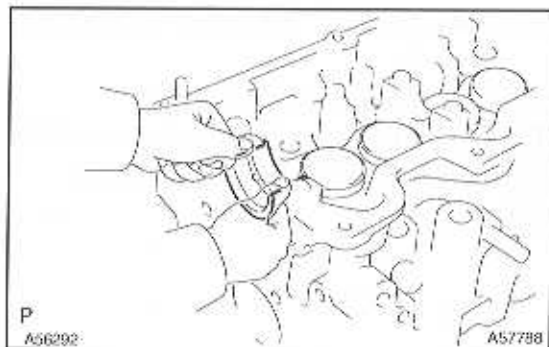
- (1) Using the crankshaft pulley bolt, turn the crankshaft, and put the timing mark of the crankshaft timing pulley with the protrusion of the timing belt case.

(b) Install the camshaft.

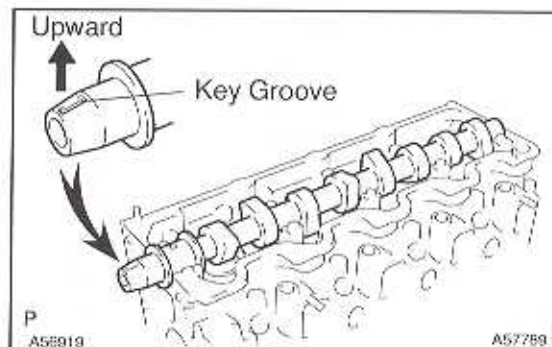
HINT:

Different the bearing are used for the No. 1 and others.

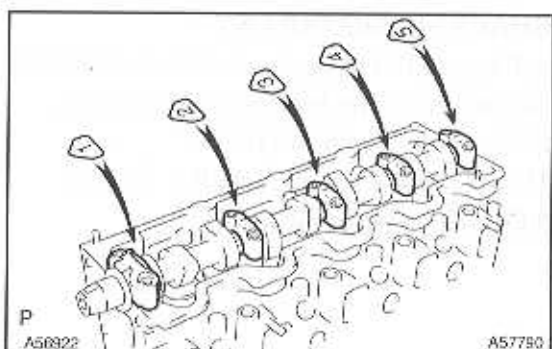




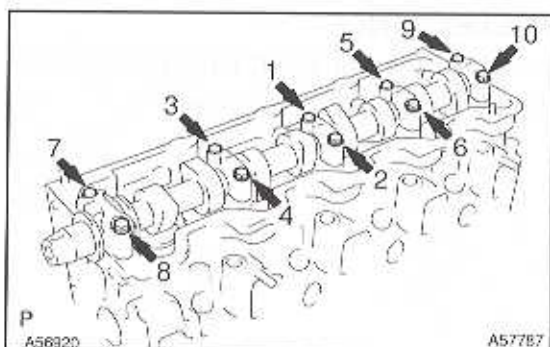
- (1) Install the 10 bearings to the bearing caps and cylinder head.



- (2) Place the camshaft on the cylinder head, facing the key groove upward.

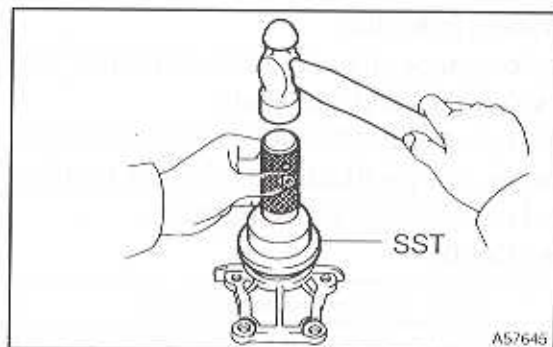


- (3) Install the 5 bearing caps in their proper locations.



- (4) Apply a light coat of engine oil on the threads and under the heads of the bearing cap bolts.
- (5) Install and uniformly tighten the 10 bearing cap bolts, in several passes, in the sequence shown.

Torque: 25 N·m (255 kgf·cm, 18 ft·lbf)



37. INSTALL OIL SEAL RETAINER, NO.2 OIL SEAL

HINT:

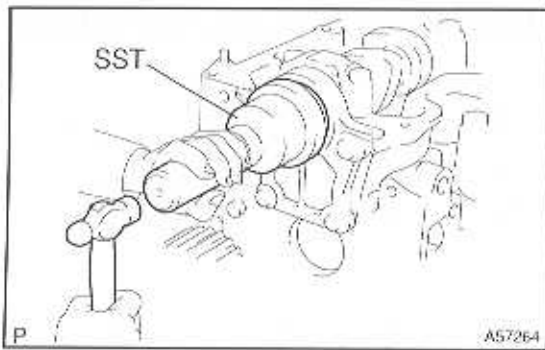
There are 2 methods ((a) and (b)) to install the oil seal.

- (a) If the camshaft oil seal retainer is removed from the cylinder head:

- (1) Using SST and a hammer, tap in a new oil seal until its surface is flush with the oil seal retainer edge.

SST 09223-46011

- (2) Apply MP grease to the oil seal lip.



- (b) If the camshaft oil seal retainer is installed to the cylinder head:

- (1) Apply MP grease to a new oil seal lip.
- (2) Using SST and a hammer, tap in the oil seal until its surface is flush with the oil seal retainer edge.

SST 09223-46011

38. INSTALL CAMSHAFT OIL SEAL RETAINER

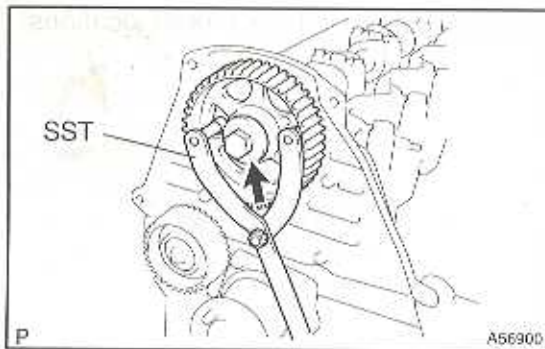
- (a) Install a new gasket and the retainer with the 4 bolts.

Torque: 18 N·m (185 kgf·cm, 13 ft·lbf)

39. INSTALL TIMING BELT NO.2 COVER

- (a) Install the timing belt cover with the 4 bolts.

Torque: 18 N·m (185 kgf·cm, 13 ft·lbf)

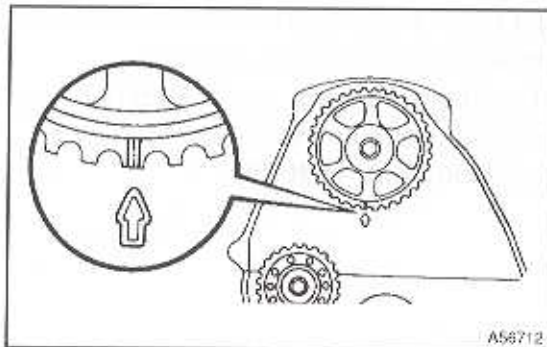


40. INSTALL CAMSHAFT TIMING PULLEY

- (a) Install the woodruff key to the key groove of the camshaft.
- (b) Align the pulley set key with the timing mark outward.
- (c) Using SST, install the pulley with the bolt.

SST 09960-10010 (09962-01000, 09963-01000)

Torque: 98 N·m (1,000 kgf·cm, 72 ft·lbf)



41. INSPECT VALVE CLEARANCE

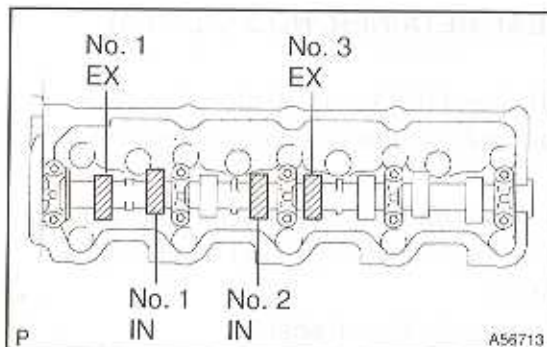
- (a) Align the timing mark of the camshaft timing pulley with the arrow mark of the timing belt No. 2 cover.

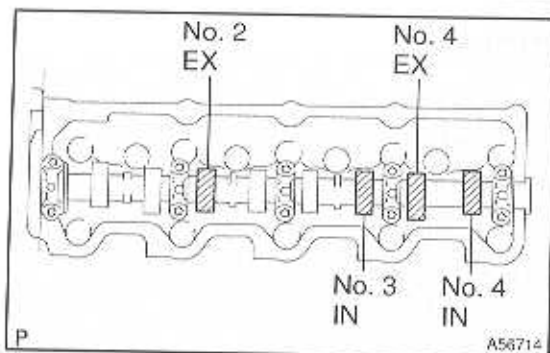
- (b) Check only the valves indicated.

- (1) Using a feeler gauge, measure the clearance between the valve lifter and camshaft.
- (2) Record the out-of-specification valve clearance measurements. They will be used later to determine the required replacement adjusting shim.

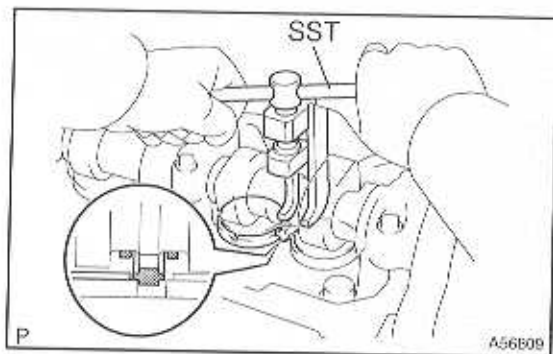
Valve clearance (Cold):

Intake	0.20 - 0.30 mm (0.008 - 0.012 in.)
Exhaust	0.40 - 0.50 mm (0.016 - 0.020 in.)



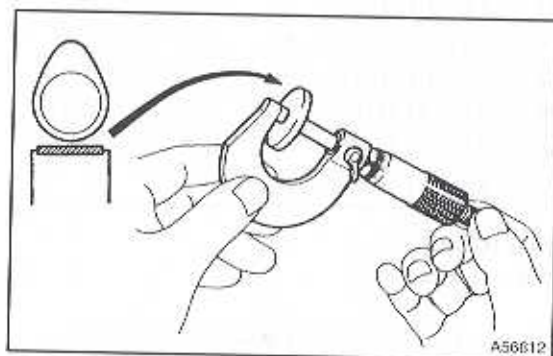
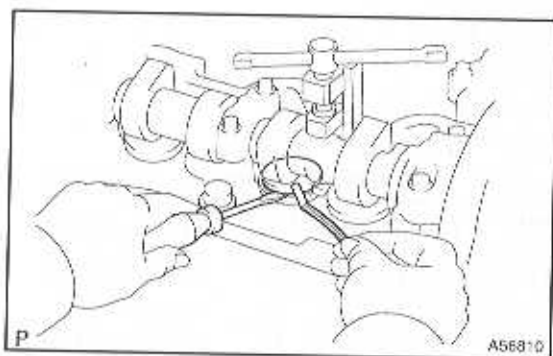


- (c) Turn the camshaft 1/2 revolutions (180°).
 (d) Check only the valves indicated as shown. Measure the valve clearance (See procedure (b) above).



42. ADJUST VALVE CLEARANCE

- (a) Remove the adjusting shim.
- (1) Turn the crankshaft so that the cam lobe of the camshaft on the adjusting valve points upward.
 - (2) Using SST, press down the valve lifter.
SST 09248-64011
 - (3) Position the notch of the valve lifter facing the exhaust manifold side.
- (4) Remove the adjusting shim with a small screwdriver and magnetic finger.



- (b) Determine the replacement adjusting shim size by following the Formula or Charts:

- (1) Using a micrometer, measure the thickness of the removed shim.
- (2) Calculate the thickness of a new shim so that the valve clearance comes within specified value.

T = Thickness of removed shim

A = Measured valve clearance

N = Thickness of new shim

Intake	$N = T + (A - 0.25 \text{ mm (0.010 in.)})$
Exhaust	$N = T + (A - 0.45 \text{ mm (0.018 in.)})$

- (3) Select a new shim with a thickness as close as possible to the calculated value.

HINT:

Shims are available in 17 sizes in increments of 0.05 mm (0.0020 in.), from 2.50 mm (0.0984 in.) to 3.30 mm (0.1299 in.).

Adjusting Shim Selection Using Chart (Intake)

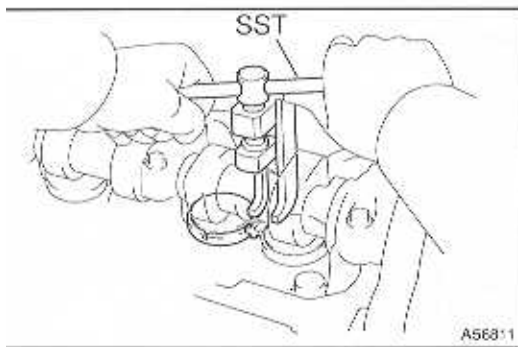
Main chart showing Measured clearance (mm and in.) vs Installed shim thickness (mm and in.). Includes a smaller inset table for Shim No. vs Thickness (mm and in.) for shims 01 through 21.

Intake valve clearance (Cold): 0.20 – 0.30 mm (0.008 – 0.012 in.)

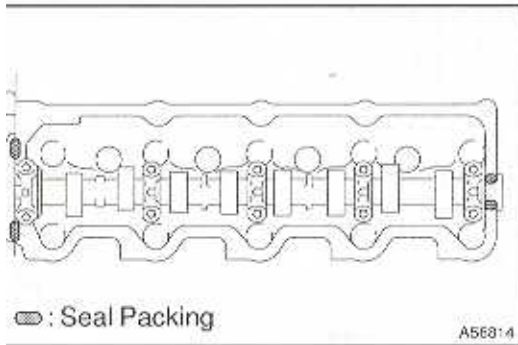
EXAMPLE:

The 2.800 mm (0.1102 in.) shim is installed and the measured clearance is 0.350 mm (0.0138 in.). Replace the 2.800 mm (0.1102 in.) shim with a No. 21 shim.

A56181



- (c) Install a new adjusting shim.
 - (1) Place a new adjusting shim on the valve lifter.
 - (2) Remove the SST.
- (d) Recheck the valve clearance.



- 43. INSTALL CYLINDER HEAD COVER SUB-ASSY**
- (a) Remove any old packing (FIPG) material.
 - (b) Apply seal packing to the cylinder head as shown in the illustration.

Seal packing: Part No. 08826-00080 or equivalent

- (c) Install the gasket to the cylinder head cover.
- (d) Install the cylinder head cover with 9 bolts and nut. Uniformly tighten the bolts and nuts in several passes.

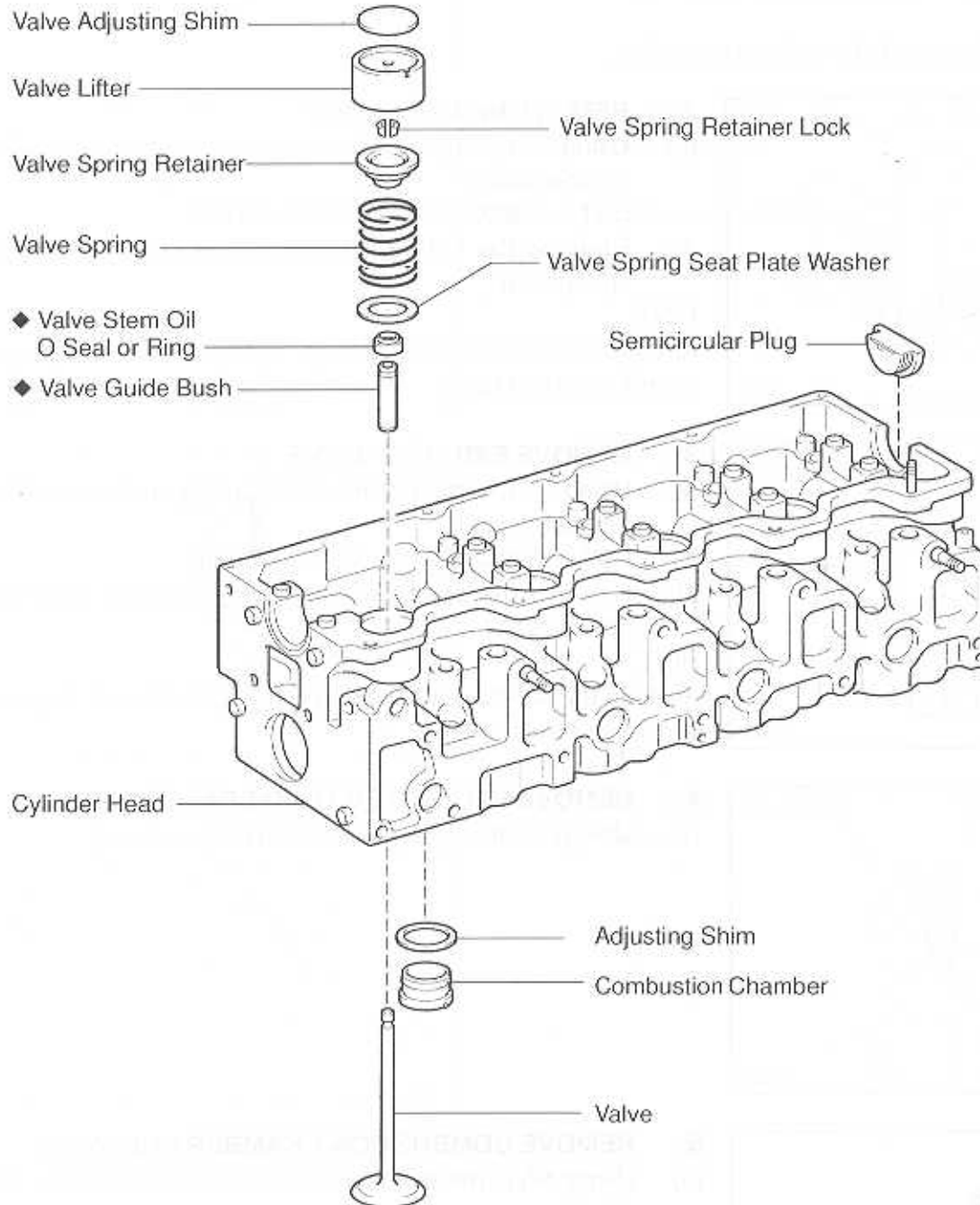
Torque: 12 N·m (120 kgf·cm, 9 ft·lbf)

I. INSTALL OIL FILLER CAP SUB-ASSY

CYLINDER HEAD ASSY (5L-E)

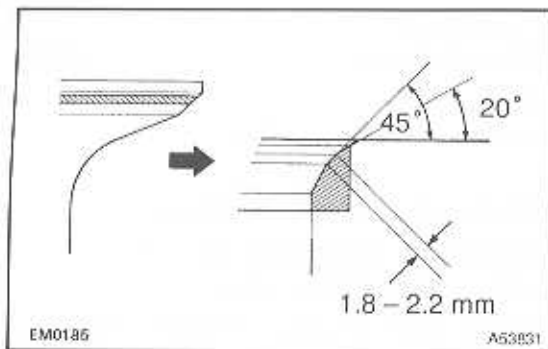
COMPONENTS

M01-01



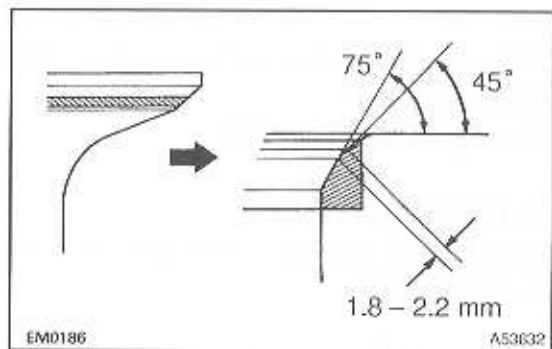
◆ Non-reusable part

A76745

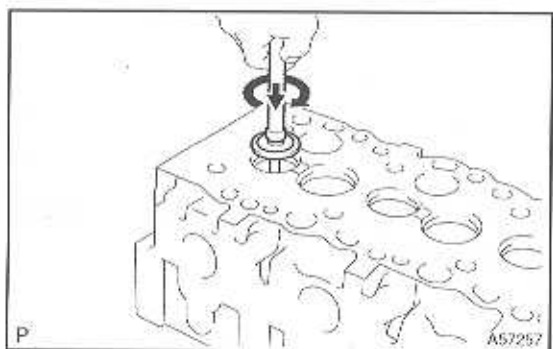


22. REPAIR EXHAUST VALVE SEATS

- (a) If the seating is too high on the valve face, use 30° and 45° cutters to correct the seat.

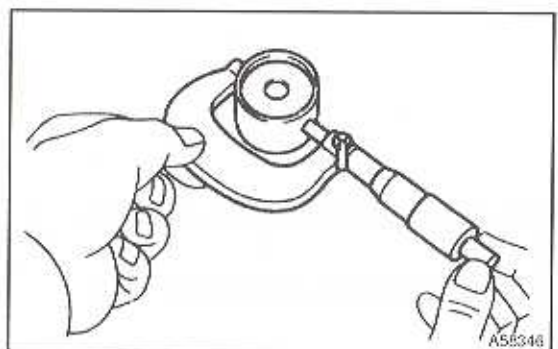


- (b) If the seating is too low on the valve face, use 60° and 45° cutters to correct the seat.



- (c) Hand-lap the valve and valve seat with an abrasive compound.

- (d) After hand-lapping, clean the valve and valve seat.

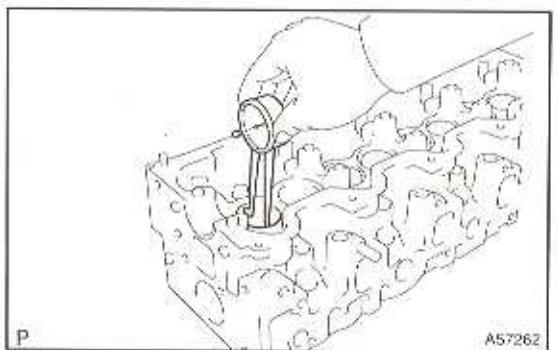


23. INSPECT VALVE LIFTER

- (a) Using a micrometer, measure the lifter diameter.

Lifter diameter:

40.892 – 40.902 mm (1.6099 – 1.6103 in.)



- (b) Using a caliper gauge, measure the lifter bore diameter of the cylinder head.

Lifter bore diameter:

40.960 – 40.980 mm (1.6126 – 1.6134 in.)

- (c) Subtract the lifter diameter measurement from the lifter bore diameter measurement.

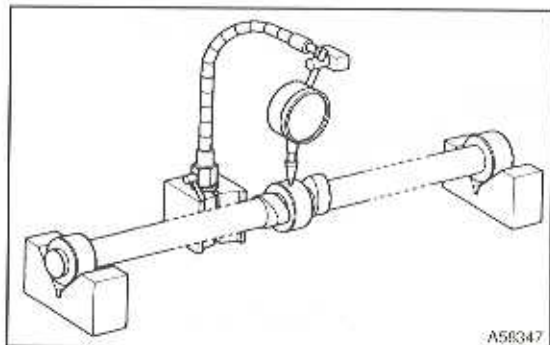
Standard oil clearance:

0.058 – 0.088 mm (0.0023 – 0.0035 in.)

Maximum oil clearance: 0.10 mm (0.0039 in.)

If the oil clearance is greater than maximum, replace the lifter.

If necessary, replace the cylinder head.



A58347

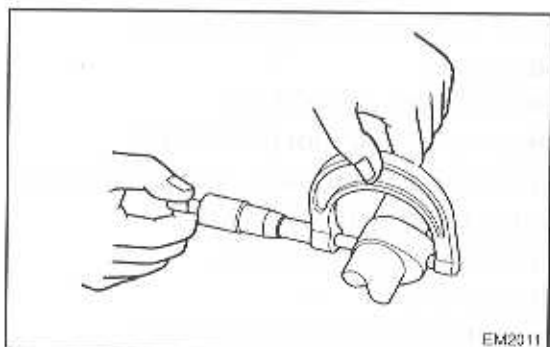
24. INSPECT CAMSHAFT

- (a) Inspect the circle runout.

- (1) Place the camshaft on V-blocks.
- (2) Using a dial indicator, measure the circle runout at the center journal.

Maximum circle runout: 0.10 mm (0.0039 in)

If the circle runout is greater than maximum, replace the camshaft.



EM2311

- (b) Using a micrometer, measure the cam lobe height.

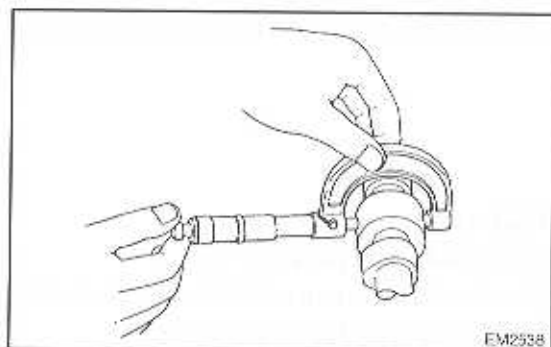
Standard cam lobe height:

Intake	54.890 – 54.910 mm (2.1610 – 2.1618 in.)
Exhaust	54.990 – 55.010 mm (2.1650 – 2.1657 in.)

Minimum cam lobe height:

Intake	54.39 mm (2.1413 in.)
Exhaust	54.49 mm (2.1453 in.)

If the cam lobe height is less than minimum, replace the camshaft.



EM2338

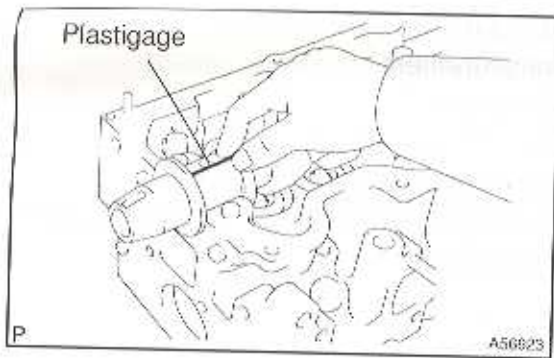
- (c) Inspect the journal diameter of the camshaft.

- (1) Using a micrometer, measure the journal diameter of the camshaft for the camshaft bearing.

Journal diameter:

STD	No. 1	34.969 – 34.985 mm (1.3767 – 1.3774 in.)
	Others	27.969 – 27.985 mm (1.1011 – 1.1018 in.)
U/S 0.125	No. 1	34.844 – 34.860 mm (1.3718 – 1.3724 in.)
	Others	27.844 – 27.860 mm (1.0962 – 1.0968 in.)
U/S 0.250	No. 1	34.719 – 34.735 mm (1.3669 – 1.3675 in.)
	Others	27.719 – 27.735 mm (1.0913 – 1.0919 in.)

If the journal diameter is not as specified, check the oil clearance.



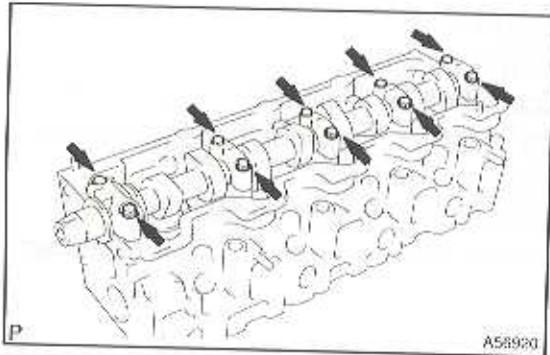
- (d) Check the oil clearance.
- (1) Clean the bearing caps and journals.
 - (2) Check that bearings for flaking and scoring.
If the bearings are damaged, If the bearings are damaged, replace the bearings.
 - (3) Install the bearings to the bearing caps and cylinder head.
 - (4) Place the camshaft on the cylinder head.
 - (5) Lay a strip of Plastigage across each of the journals.

- (6) Install the bearing caps (See page 14-3).

NOTICE:

Do not turn the camshaft.

- (7) Remove the bearing caps.



- (8) Measure the Plastigage at its widest point.

Standard oil clearance:

0.022 – 0.074 mm (0.0009 – 0.0029 in.)

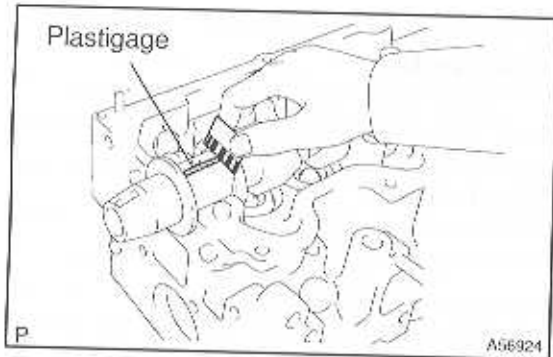
Maximum oil clearance: 0.10 mm (0.0039 in.)

If the oil clearance is greater than maximum, replace the bearings. If necessary, grind or replace the camshaft.

- (9) Completely remove the Plastigage.
- (10) Remove the camshaft.

- (e) If necessary, grind and hone camshaft journals.

- (1) Grind and hone the journals to U/S diameter (See procedure (c) above). Install new journal U/S bearings.



- (f) Check the thrust clearance.

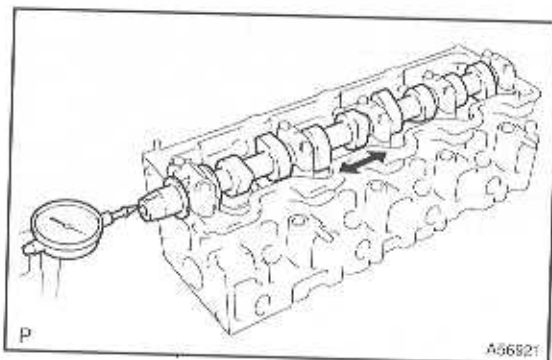
- (1) Install the camshaft (See page 14-3).
- (2) Using a dial indicator, measure the thrust clearance while moving the camshaft back and forth.

Standard thrust clearance:

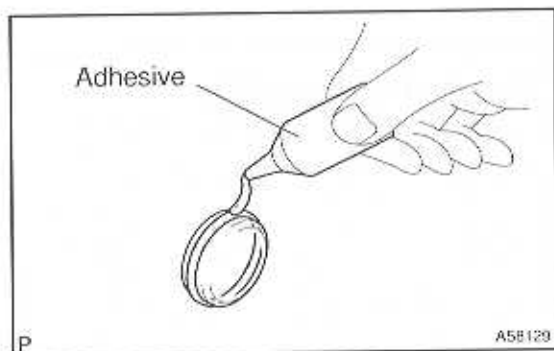
0.080 – 0.280 mm (0.0031 – 0.0110 in.)

Maximum thrust clearance: 0.35 mm (0.0138 in.)

If the thrust clearance is greater than maximum, replace the No.1 bearing. If necessary, replace the camshaft.



25. REMOVE SEMICIRCULAR PLUG



26. INSTALL TIGHT PLUG

- (a) Apply adhesive to the tight plug.

Adhesive:

Part No. 08833-00070, THREE BOND 1324 or equivalent

- (b) Using SST and a hammer, tap in a new tight plug as shown in the illustration.

SST Position A:

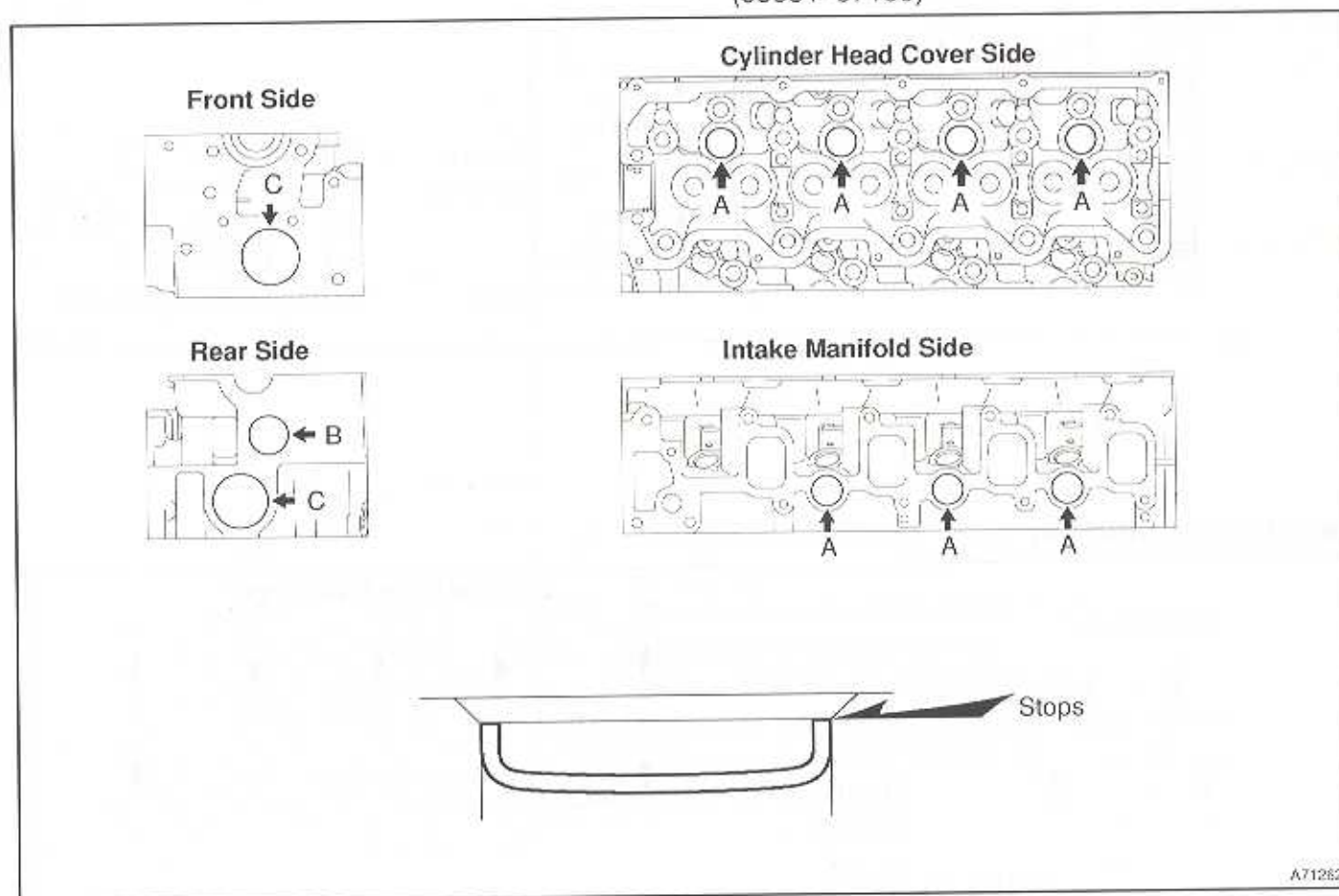
09950-60010 (09951-00250), 09950-70010 (09951-07100)

Position B:

09950-60010 (09951-00300), 09950-70010 (09951-07100)

Position C:

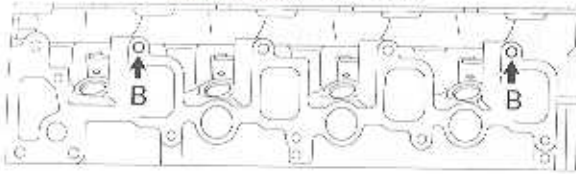
09950-60010 (09951-00450), 09950-70010 (09951-07100)



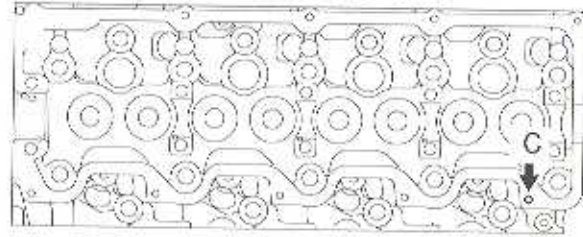
A71262

27. INSTALL STUD BOLT

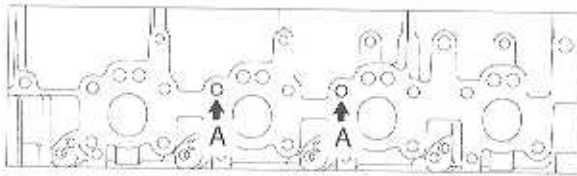
Intake Manifold Side



Cylinder Head Cover Side



Exhaust Manifold Side

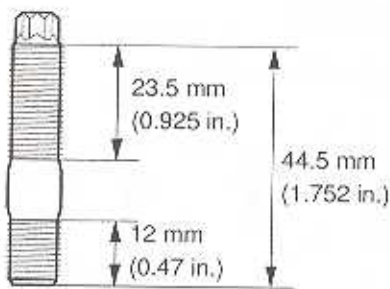


Torque:

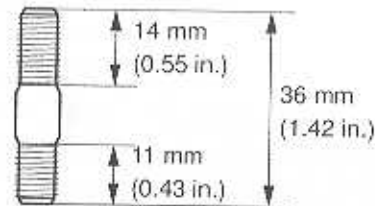
26 N·m (265 kgf·cm, 19 ft·lbf) for A

12 N·m (120 kgf·cm, 9 ft·lbf) for B

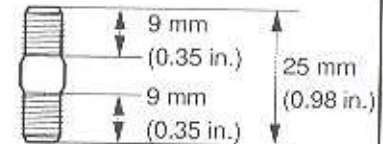
6.0 N·m (60 kgf·cm, 53 in·lbf) for C



A (Thread diameter: 10 mm)



B (Thread diameter: 8 mm)

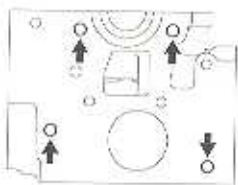


C (Thread diameter: 6 mm)

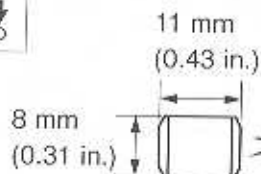
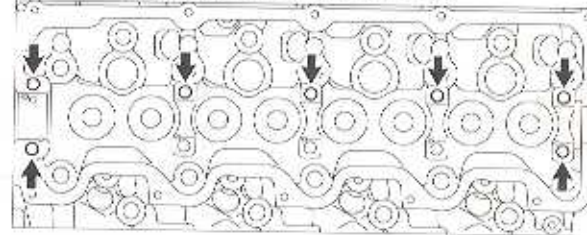
A71263

28. INSTALL RING PIN

Front Side

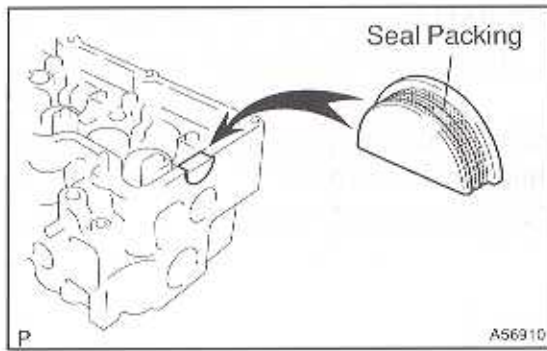


Cylinder Head Cover Side



Until pin stops

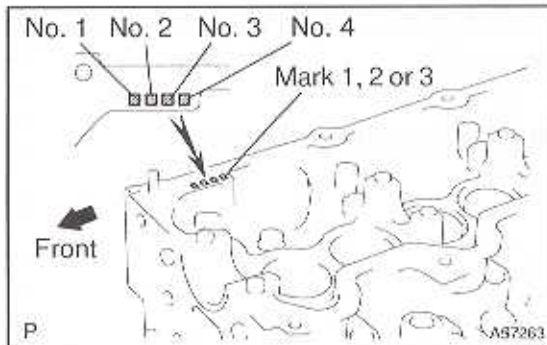
A71264

**29. INSTALL SEMICIRCULAR PLUG**

- (a) Remove any old packing (FIPG) material.
- (b) Apply seal packing to the semicircular plug as shown in the illustration.

Seal packing: Part No. 08826-00080 or equivalent

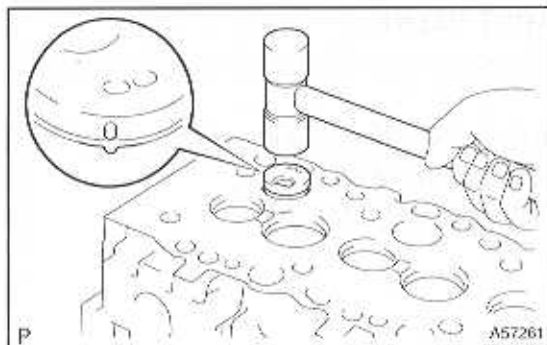
- (c) Install the semicircular plug to the cylinder head.

**30. INSTALL COMBUSTION CHAMBER SUB-ASSY**

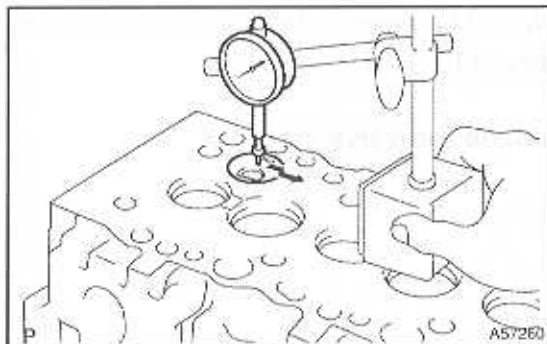
- (a) Select the number of shim, depending on the table below.

Number mark of cylinder head	Number of shim
1	0
2	0
	1
3	1
	2

Shim thickness: 0.03 mm (0.0012 in.)



- (b) Align the combustion chamber knock pin with the cylinder head notch.
- (c) Using a plastic-faced hammer, tap in the combustion chamber.



- (d) Using a dial indicator, check the combustion chamber protrusion.

Combustion chamber protrusion:

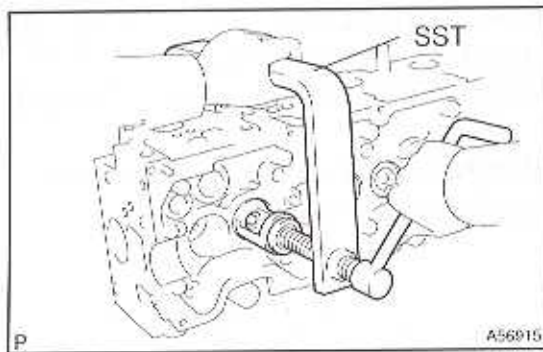
Minus 0.03 – Plus 0.03 mm

(Minus 0.0012 – Plus 0.0012 in.)

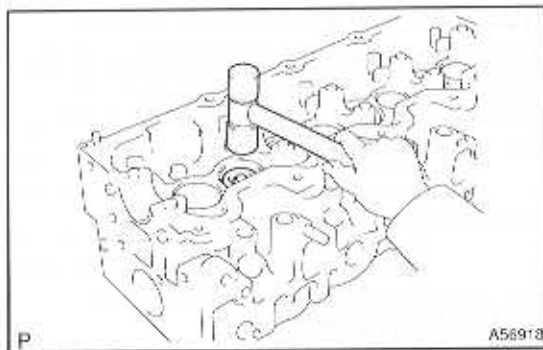
If the protrusion is less than specified, adjust with shims.

If the protrusion is greater than specified, replace the chamber and recheck the protrusion.

31. INSTALL VALVE STEM OIL O SEAL OR RING

**32. INSTALL INTAKE VALVE**

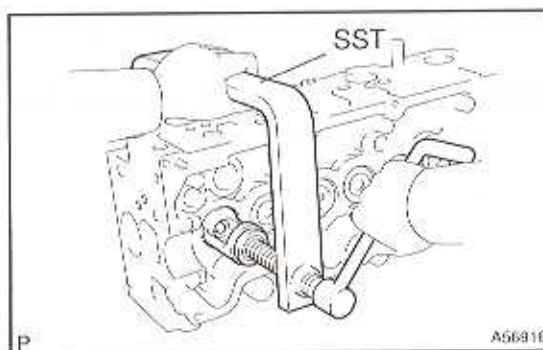
- (a) Install the valve, spring seat, valve spring and spring retainer.
- (b) Using SST, compress the valve spring and place the 2 retainer locks around the valve stem.
SST 09202-70020 (09202-00030)



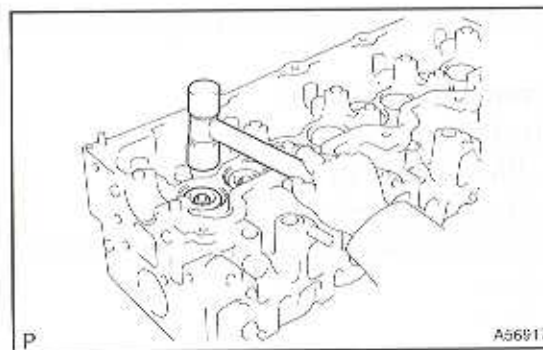
- (c) Using a plastic-faced hammer, lightly tap the valve stem tip to assure a proper fit.

NOTICE:

Be careful not to damage the valve stem tip.

**33. INSTALL EXHAUST VALVE**

- (a) Install the valve, spring seat, valve spring and spring retainer.
- (b) Using SST, compress the valve spring and place the 2 retainer locks around the valve stem.
SST 09202-70020 (09202-00030)



- (c) Using a plastic-faced hammer, lightly tap the valve stem tip to assure a proper fit.

NOTICE:

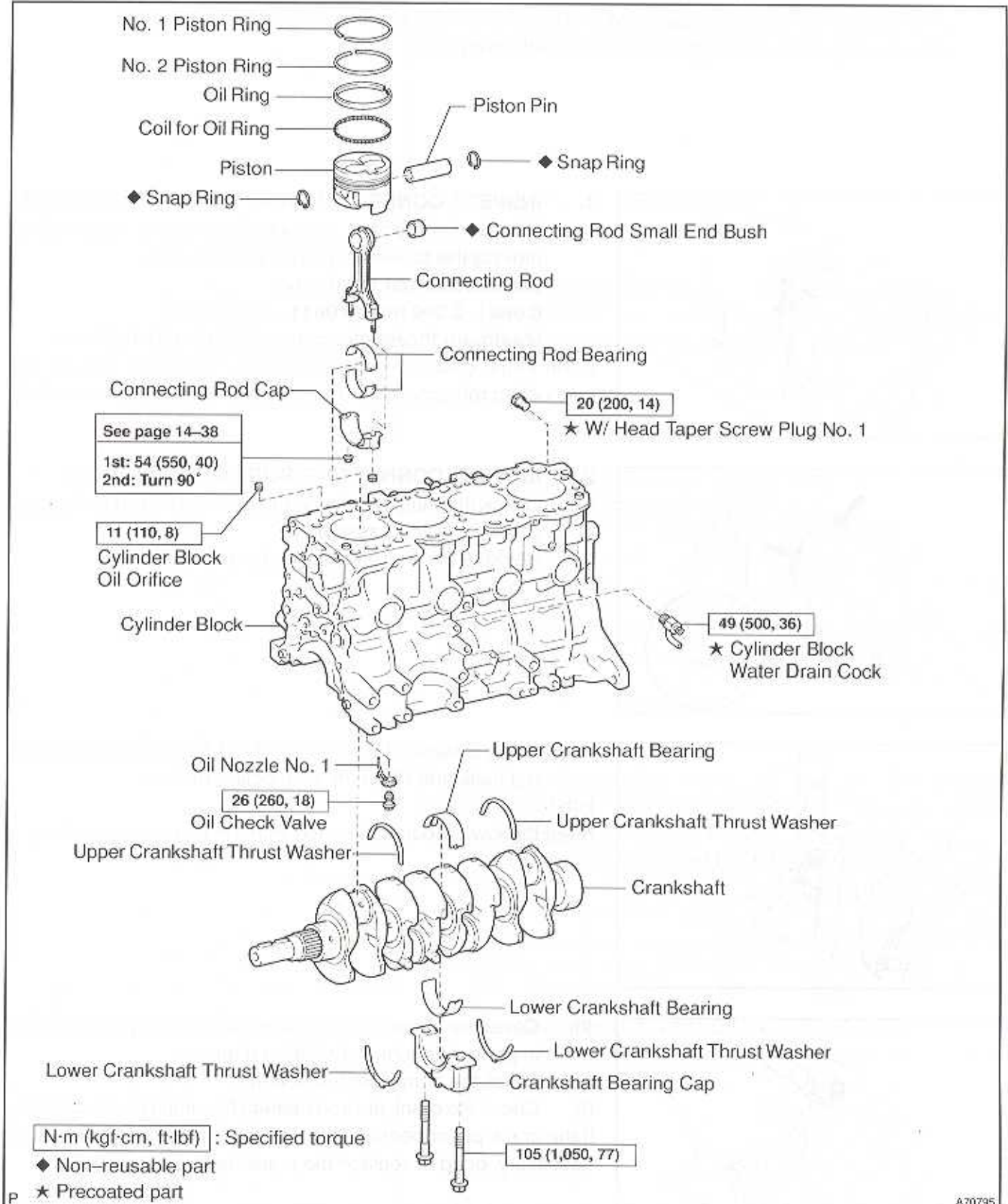
Be careful not to damage the valve stem tip.

34. INSTALL VALVE LIFTER

- (a) Install the valve lifter and shim.
- (b) Check that the valve lifter rotates smoothly by hand.

CYLINDER BLOCK ASSY (5L-E) COMPONENTS

1412-01

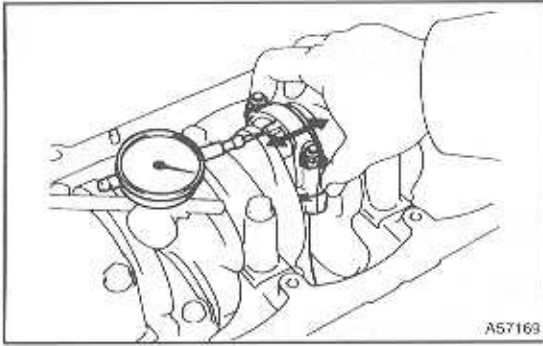


A70795

OVERHAUL

HINT:

- Thoroughly clean all parts to be assembled.
- Before installing the parts, apply new engine oil to all sliding and rotating surfaces.
- Replace all gaskets, O-rings and oil seals with new parts.



1. INSPECT CONNECTING ROD THRUST CLEARANCE

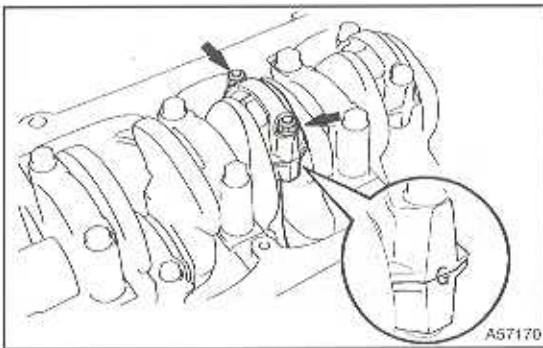
- (a) Using a dial indicator, measure the thrust clearance while moving the connecting rod back and forth.

Standard thrust clearance:

0.080 – 0.300 mm (0.0031 – 0.0118 in.)

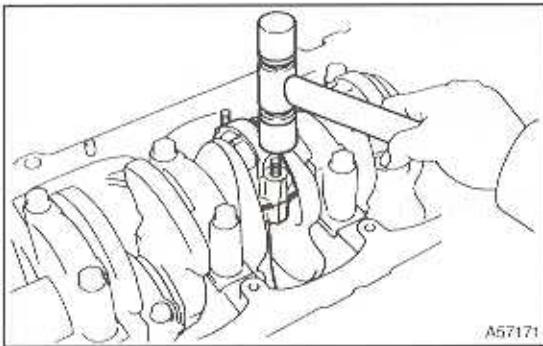
Maximum thrust clearance: 0.35 mm (0.0138 in.)

If the thrust clearance is greater than maximum, replace the connecting rod assembly. If necessary, replace the crankshaft.



2. INSPECT CONNECTING ROD OIL CLEARANCE

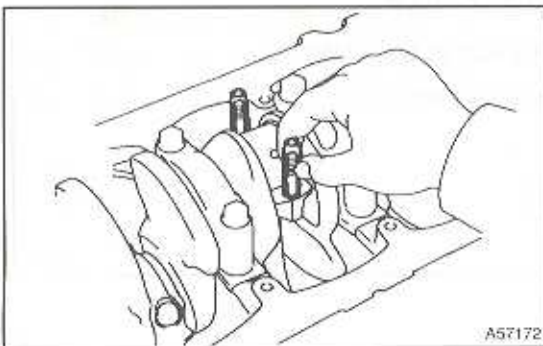
- (a) Check the matchmarks on the connecting rod and cap to ensure correct reassembly.
- (b) Remove the 2 connecting rod cap nuts.



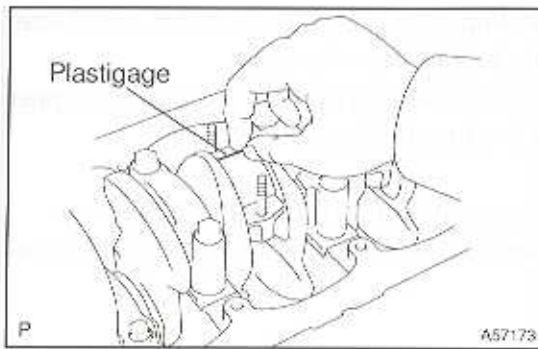
- (c) Using a plastic-faced hammer, lightly tap the connecting rod bolts and lift off the connecting rod cap.

HINT:

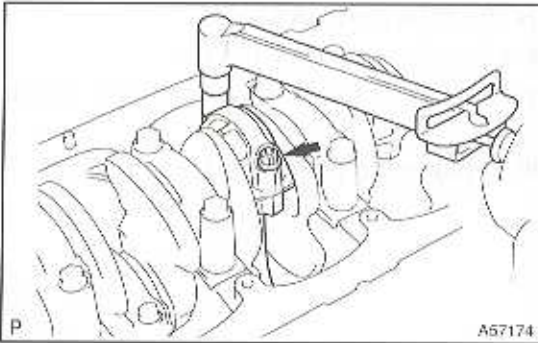
Keep the lower bearing inserted with the connecting rod cap.



- (d) Cover the connecting rod bolts with a short piece of hose to protect the crankshaft from damage.
- (e) Clean the crank pin and bearing.
- (f) Check the crank pin and bearing for pitting and scratches. If the crank pin or bearing is damaged, replace the bearings. If necessary, grind or replace the crankshaft.



(g) Lay a strip of plastigage across the crank pin.

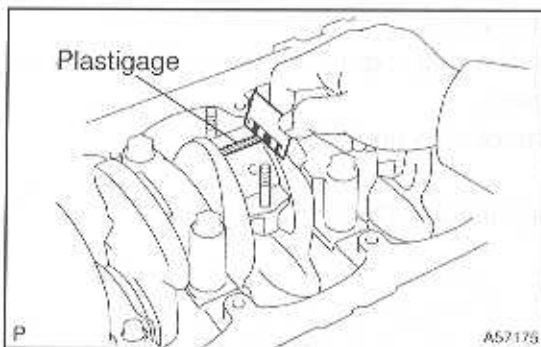


(h) Install the connecting rod cap with the 2 nuts (See step 40).

NOTICE:

Do not turn the crankshaft.

(i) Remove the 2 nuts, connecting rod cap and lower bearing (See procedure (b) and (c) above).



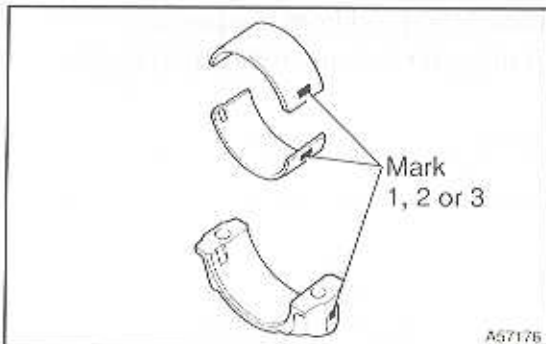
(j) Measure the plastigage at its widest point.

Standard oil clearance:

STD	0.036 – 0.064 mm (0.0014 – 0.0025 in.)
U/S 0.25, U/S 0.50	0.033 – 0.079 mm (0.0013 – 0.0031 in.)

Maximum oil clearance: 0.10 mm (0.0039 in.)

If the oil clearance is greater than maximum, replace the bearings. If necessary, grind or replace the crankshaft.



HINT:

If using a standard bearing, replace it with one having the same number marked on the connecting rod cap. There are 3 sizes of standard bearings, marked 1, 2 and 3 accordingly.

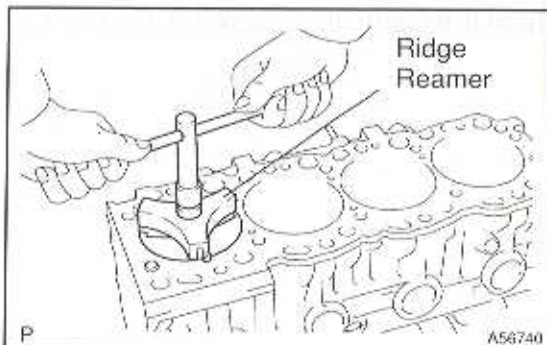
Standard sized bearing center wall thickness:

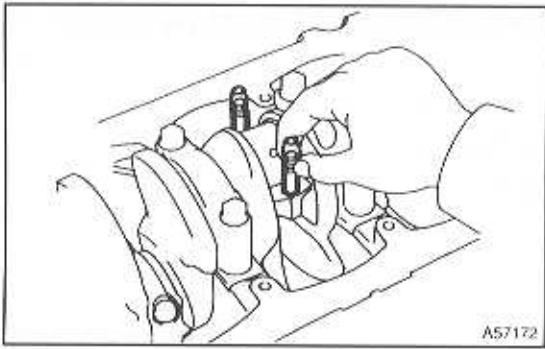
Mark 1	1.478 – 1.482 mm (0.0582 – 0.0583 in.)
Mark 2	1.482 – 1.486 mm (0.0583 – 0.0585 in.)
Mark 3	1.486 – 1.490 mm (0.0585 – 0.0587 in.)

(1) Completely remove the plastigage.

3. REMOVE PISTON AND CONNECTING ROD

(a) Using a ridge reamer, remove all the carbon from the top of the cylinder.

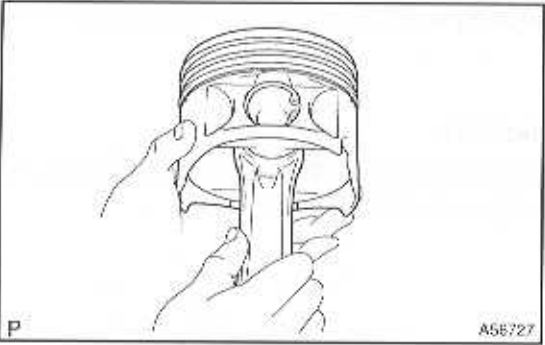




- (b) Cover the connecting rod bolts with a short piece of hose to protect the crankshaft from damage.
- (c) Push the piston, connecting rod assembly and upper bearing through the top of the cylinder block.

HINT:

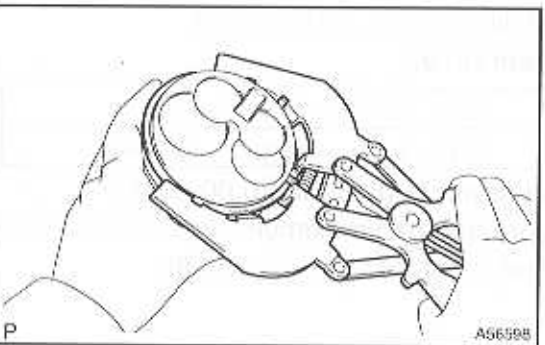
- Keep the bearings, connecting rod and cap together.
- Arrange the piston and connecting rod assemblies in correct order.

**4. REMOVE W/PIN PISTON SUB-ASSY**

- (a) Check fit between the piston and piston pin.

- (1) Try to move the piston back and forth on the piston pin.

If any movement is felt, replace the piston and pin as a set.

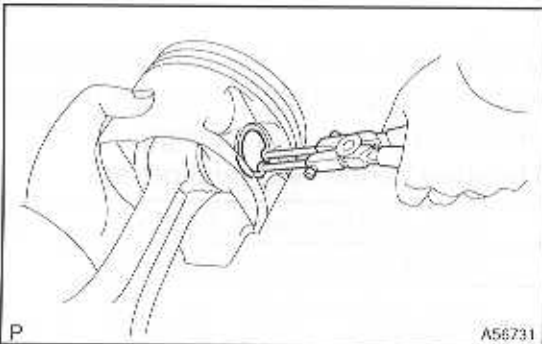


- (b) Remove the piston rings.

- (1) Using a piston ring expander, remove the 2 compression rings.
- (2) Remove the oil ring and coil by hand.

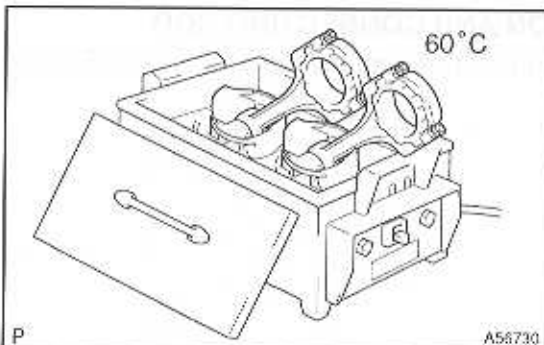
HINT:

Arrange the piston rings in correct order only.

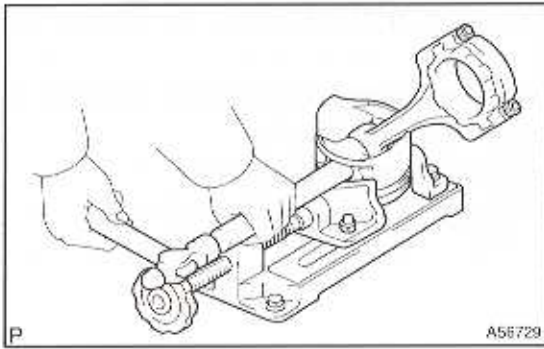


- (c) Disconnect the connecting rod from the piston.

- (1) Using snap ring pliers, remove the snap rings.



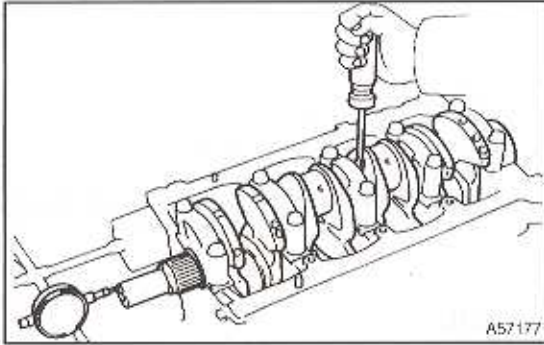
- (2) Gradually heat the piston to approx. 60°C (140°F).



- (3) Using a plastic-faced hammer and brass bar, lightly tap out the piston pin and pin and remove the connecting rod.

HINT:

- The piston and pin are a matched set.
- Arrange the pistons, pins, rings, connecting rods and bearings in correct order.

**5. INSPECT CRANKSHAFT THRUST CLEARANCE**

- (a) Using a dial indicator, measure the thrust clearance while prying the crankshaft back and forth with a screwdriver.

Standard thrust clearance:

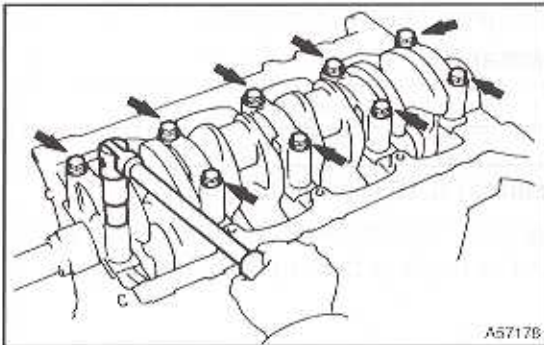
0.040 – 0.250 mm (0.0016 – 0.0098 in.)

Maximum thrust clearance: 0.30 mm (0.0118 in.)

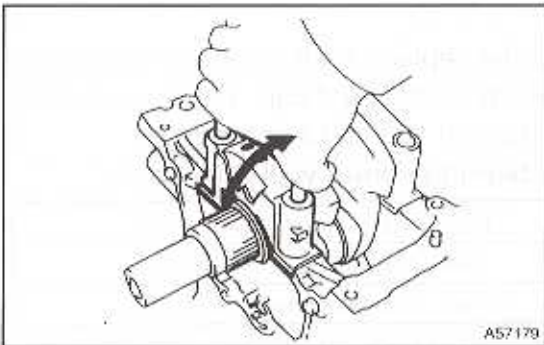
If the thrust clearance is greater than maximum, replace the thrust washers as a set.

Thrust washer thickness:

STD	2.430 – 2.480 mm (0.0957 – 0.0976 in.)
O/S 0.125	2.493 – 2.543 mm (0.0981 – 0.1001 in.)
O/S 0.250	2.555 – 2.605 mm (0.1006 – 0.1026 in.)

**6. INSPECT CRANKSHAFT OIL CLEARANCE**

- (a) Remove the 10 crankshaft bearing cap bolts.



- (b) Using the removed crankshaft bearing cap bolts, pry the cap back and forth, and remove the crankshaft bearing caps, lower bearings and lower thrust washers (No. 3 crankshaft bearing cap only).

HINT:

- Keep the lower bearing and crankshaft bearings cap together.
 - Arrange the thrust washers in correct order.
- (c) Lift out the crankshaft.

HINT:

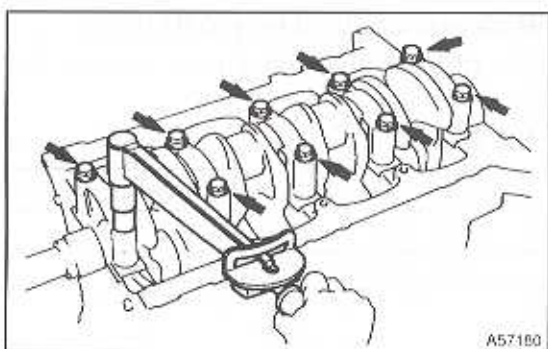
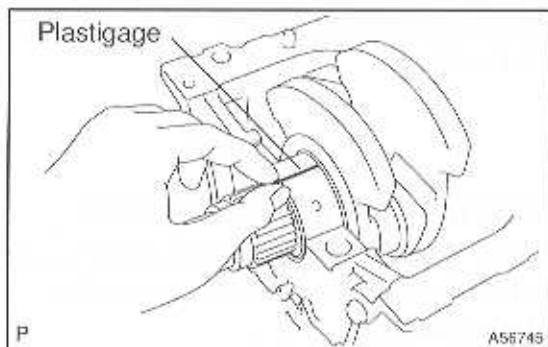
Keep the upper crankshaft bearings and upper thrust washers together with the cylinder block.

- (d) Clean each main journal and bearing.

- (e) Check each main journal and bearing for pitting and scratches.

If the journal or bearing is damaged, replace the bearings. If necessary, grind or replace the crankshaft.

- (f) Place the crankshaft on the cylinder block.
 (g) Lay a strip of Plastigage across each journal.

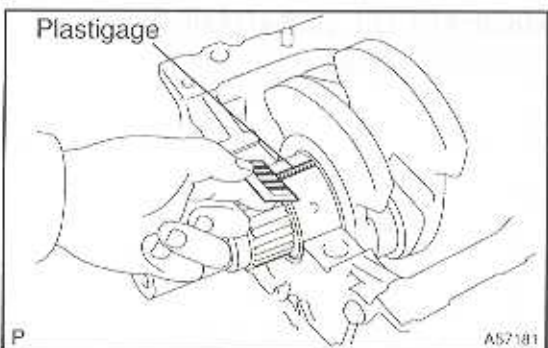


- (h) Install the 5 crankshaft bearing caps with the 10 bolts (See step 39).

NOTICE:

Do not turn the crankshaft.

- (i) Remove the 10 bolts and 5 crankshaft bearing caps (See procedure (a) and (b) above).



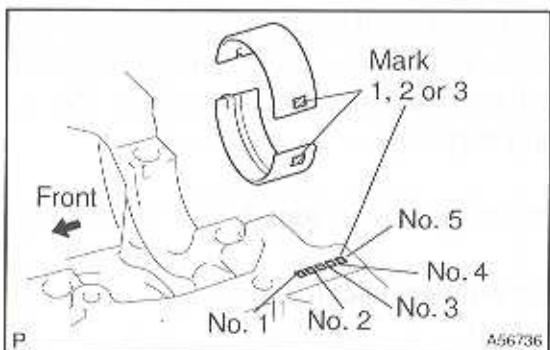
- (j) Measure the plastigage at its widest point.

Standard oil clearance:

STD	0.034 – 0.065 mm (0.0013 – 0.0026 in.)
U/S 0.25, U/S 0.50	0.033 – 0.079 mm (0.0013 – 0.0031 in.)

Maximum clearance: 0.10 mm (0.0039 in.)

If the oil clearance is greater than maximum, replace the bearings. If necessary, grind or replace the crankshaft.



HINT:

If using a standard bearing, replace it with one having the same number marked on the connecting rod cap. There are 3 sizes of standard bearings, marked 1, 2 and 3 accordingly.

Standard sized bearing center wall thickness:

Mark 1	1.979 – 1.983 mm (0.0779 – 0.0781 in.)
Mark 2	1.983 – 1.987 mm (0.0781 – 0.0782 in.)
Mark 3	1.987 – 1.991 mm (0.0782 – 0.0784 in.)

- (k) Completely remove the plastigage.

7. REMOVE CRANKSHAFT

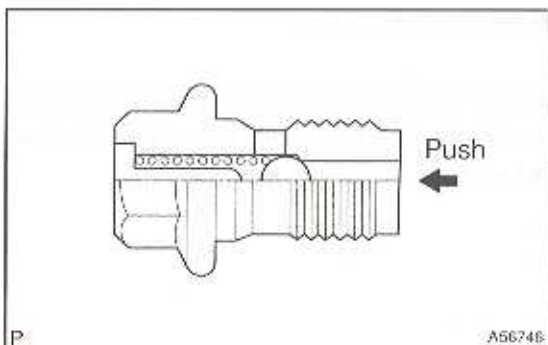
- (a) Lift out the crankshaft.
- (b) Remove the upper bearings and upper thrust washers from the cylinder block.

HINT:

Arrange the crankshaft bearing caps, bearings and thrust washers in correct order.

8. REMOVE SUB-ASSY OIL NOZZLE NO.1

- (a) Remove the 4 check valves and oil nozzles.

**9. INSPECT OIL CHECK VALVE SUB-ASSY**

- (a) Push the valve with a wooden stick to check if it is stuck. If stuck, replace the check valve.

10. INSPECT SUB-ASSY OIL NOZZLE NO.1

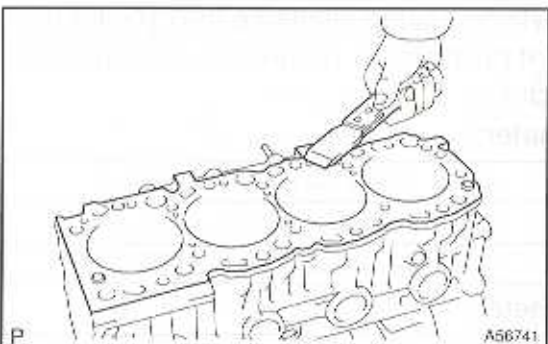
- (a) Check the oil nozzles for damage or clogging. If necessary, replace the oil nozzle.

11. REMOVE CYLINDER BLOCK OIL ORIFICE

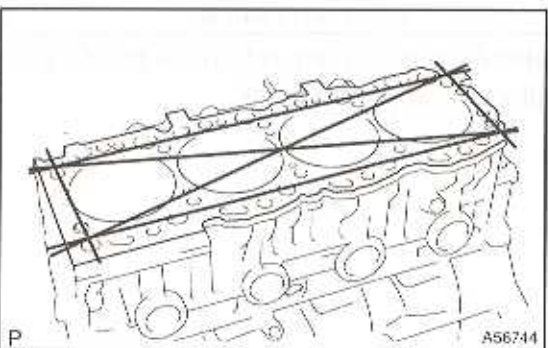
- (a) Using a 6 mm hexagon wrench, remove the oil orifice.

12. INSPECT CYLINDER BLOCK OIL ORIFICE

- (a) Check the oil orifice for damage or clogging. If necessary, replace the oil orifice.

13. REMOVE CYLINDER BLOCK WATER DRAIN COCK SUB-ASSY**14. REMOVE W/HEAD TAPER SCREW PLUG NO.1****15. CLEAN CYLINDER BLOCK SUB-ASSY**

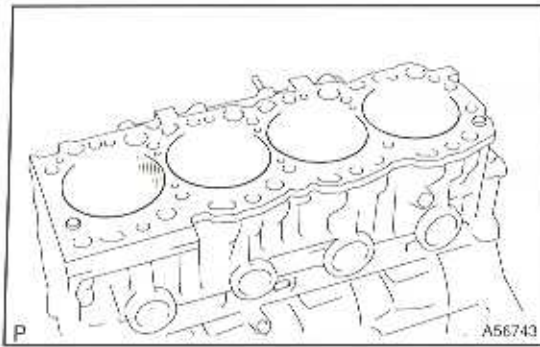
- (a) Using a gasket scraper, remove all the gasket material from the top surface of the cylinder block.
- (b) Using a soft brush and solvent, thoroughly clean the cylinder block.

**16. INSPECT CYLINDER BLOCK SUB-ASSY**

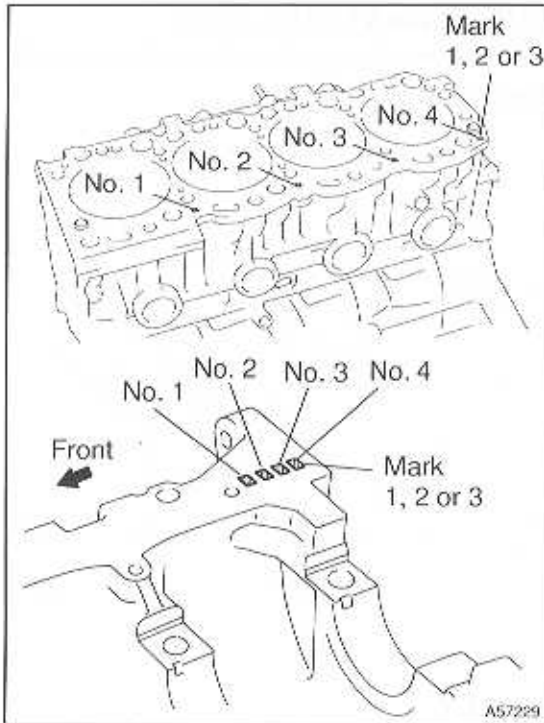
- (a) Inspect for flatness.
 - (1) Using a precision straight edge and feeler gauge, measure the surface contacting the cylinder head cap for warpage.

Maximum warpage: 0.20 mm (0.0079 in.)

If warpage is greater than maximum, replace the cylinder block.



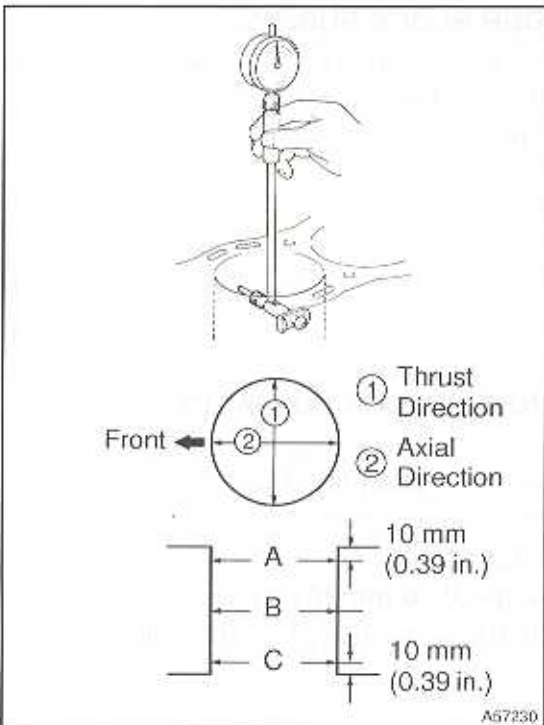
(b) Visually check the cylinder for vertical scratches. If deep scratches are present, rebore all the 4 cylinders. If necessary, replace the cylinder block.



(c) Inspect the cylinder bore diameter.

HINT:

There are 3 sizes of the standard cylinder bore diameter, marked 1, 2 and 3 accordingly. The mark is stamped on the lower left rear of the cylinder block.



(1) Using a cylinder gauge, measure the cylinder bore diameter at positions A, B and C in the thrust and axial directions.

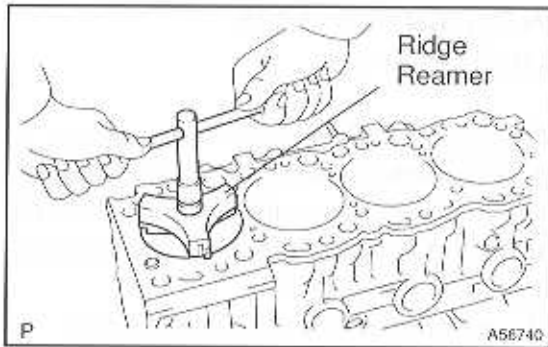
Standard diameter:

Mark 1	99.500 – 99.510 mm (3.9173 – 3.9177 in.)
Mark 2	99.510 – 99.520 mm (3.9177 – 3.9181 in.)
Mark 3	99.520 – 99.530 mm (3.9181 – 3.9185 in.)

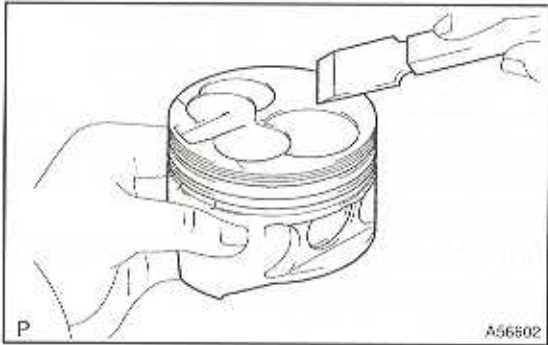
Maximum diameter:

STD	99.73 mm (3.9264 in.)
O/S 0.50	100.23 mm (3.9461 in.)

If the diameter is greater than maximum, rebore all the 4 cylinders. If necessary, replace the cylinder block.

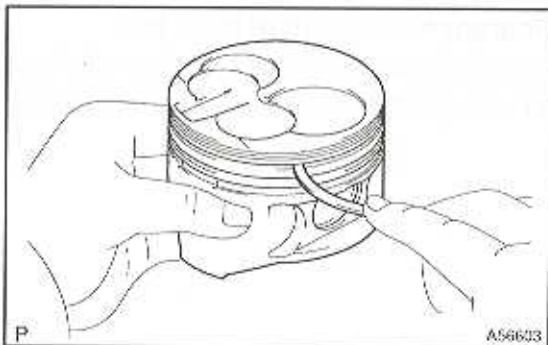


- (d) Remove the cylinder ridge.
If the wear is less than 0.2 mm (0.008 in.), using a ridge reamer, grind the top of the cylinder.

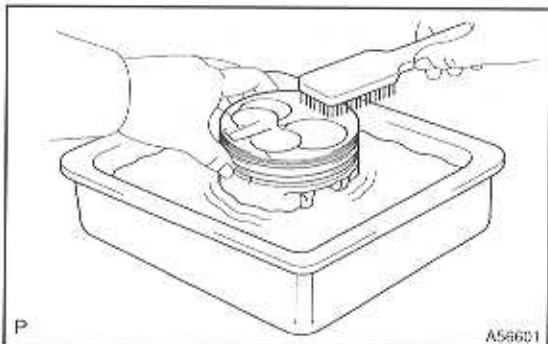


17. CLEAN W/PIN PISTON SUB-ASSY

- (a) Using a gasket scraper, remove the carbon from the piston top.



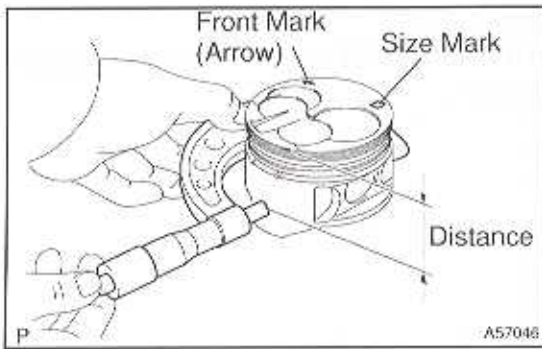
- (b) Using a groove cleaning tool or broken ring, clean the piston ring grooves.



- (c) Using solvent and a brush, thoroughly clean the piston.

NOTICE:

Do not use a wire brush.

**18. INSPECT W/PIN PISTON SUB-ASSY**

(a) Inspect the piston oil clearance.

HINT:

There are 3 sizes of the standard piston diameter, marked "1", "2" and "3" accordingly. The mark is stamped on the piston top.

- (1) Using a micrometer, measure the piston diameter at right angles to the piston center line, the indicated distance from the piston head.

Distance: 61.27 – 61.33 mm (2.4122 – 2.4146 in.)

Piston diameter:

STD.	Mark 1	99.450 – 99.460 mm (3.9153 – 3.9157 in.)
	Mark 2	99.460 – 99.470 mm (3.9157 – 3.9161 in.)
	Mark 3	99.470 – 99.480 mm (3.9161 – 3.9165 in.)
O/S 0.50		99.950 – 99.980 mm (3.9350 – 3.9362 in.)

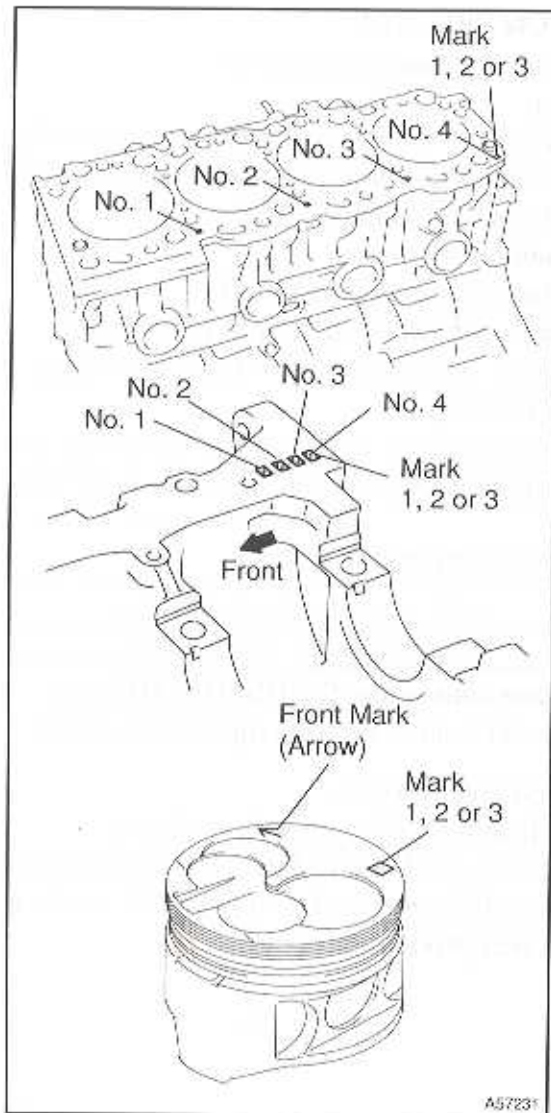
- (2) Measure the cylinder bore diameter in the thrust directions (See step 16).
- (3) Subtract the piston diameter measurement from the cylinder bore diameter measurement.

Standard oil clearance:

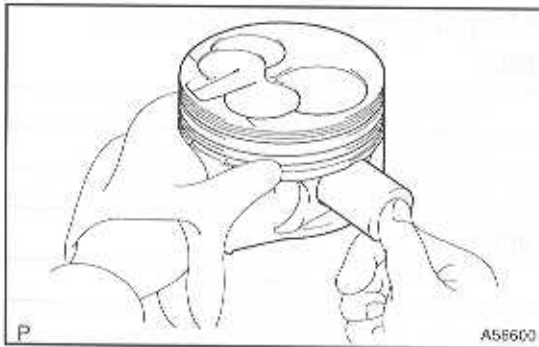
0.040 – 0.060 mm (0.0016 – 0.0024 in.)

Maximum oil clearance: 0.13 mm (0.0051 in.)

If the oil clearance is greater than maximum, replace all the 4 pistons and rebore all the 4 cylinders. If necessary, replace the cylinder block.

**HINT:**

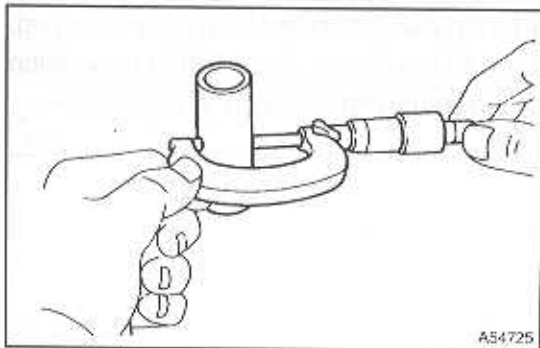
Use a piston with the same number mark as the cylinder bore diameter marked on the cylinder block.



(b) Inspect the piston pin fit.

- (1) At 60°C (140°F), you should be able to push the piston pin into the piston pin hole with your thumb.

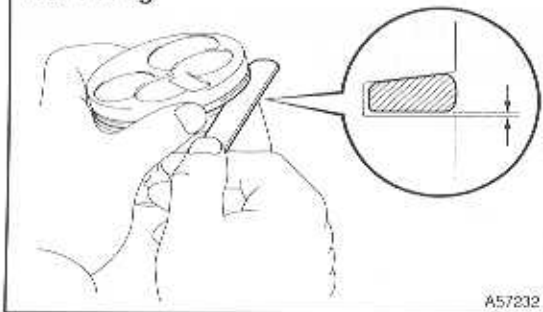
If the pin can be installed at a lower temperature, replace the piston and pin as set.



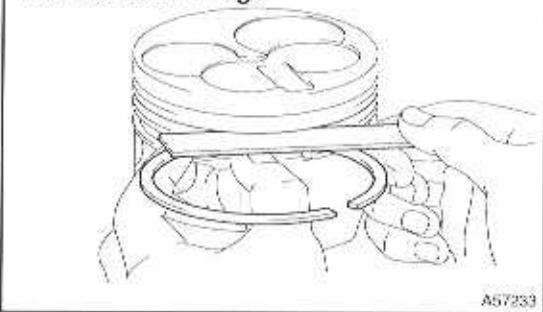
(c) Using a micrometer, measure the piston pin diameter.

Piston pin diameter:

29.000 – 29.012 mm (1.1417 – 1.1422 in.)

No. 1 Ring

A57232

No. 2 and Oil Rings

A57233

19. INSPECT PISTON RING SET

(a) Inspect the piston ring groove clearance.

(1) No. 1 Ring:

Install a new piston ring to the piston. Using a feeler gauge, measure the clearance between the piston ring and the wall of the ring groove.

Standard groove clearance:**0.057 – 0.101 mm (0.0022 – 0.0040 in.)****Maximum groove clearance: 0.20 mm (0.0079 in.)**

If the clearance is greater than maximum, replace the piston.

(2) No. 2 and Oil Rings:

Using a feeler gauge, measure the clearance between a new piston ring and the wall of the ring groove.

Standard groove clearance:

No. 2	0.060 – 0.100 mm (0.0024 – 0.0039 in.)
Oil	0.030 – 0.070 mm (0.0012 – 0.0028 in.)

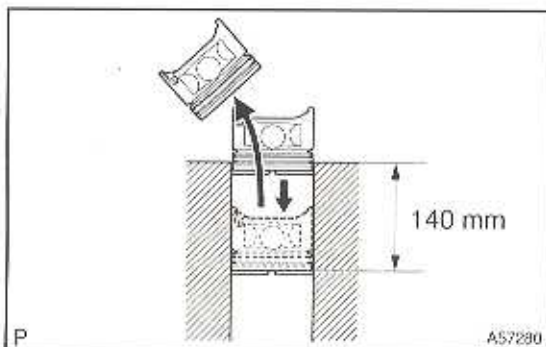
Maximum groove clearance: 0.20 mm (0.0079 in.)

If the clearance is greater than maximum, replace the piston.

(b) Inspect the piston ring end gap.

(1) Insert the piston ring into the cylinder bore.

(2) Using a piston, push the piston ring a little beyond the bottom of the ring travel, 140 mm (5.51 in.) from the top of the cylinder block.



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A57280

(3) Using a feeler gauge, measure the end gap.

Standard end gap:

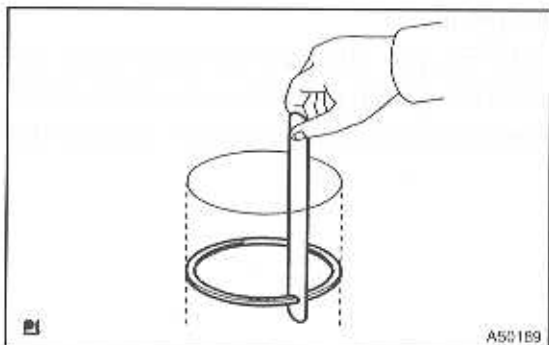
No. 1	0.350 – 0.590 mm (0.0138 – 0.0232 in.)
No. 2	0.470 – 0.720 mm (0.0185 – 0.0283 in.)
Oil	0.200 – 0.520 mm (0.0079 – 0.0205 in.)

Maximum end gap:

No. 1	1.29 mm (0.0508 in.)
No. 2	1.42 mm (0.0559 in.)
Oil	1.22 mm (0.0480 in.)

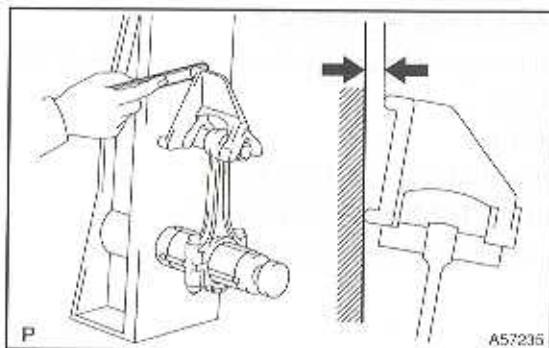
If the end gap is greater than maximum, replace the piston ring.

If the end gap is greater than maximum, even with a new piston ring, rebore all the 4 cylinders or replace the cylinder block.



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A50189



20. INSPECT CONNECTING ROD SUB-ASSY

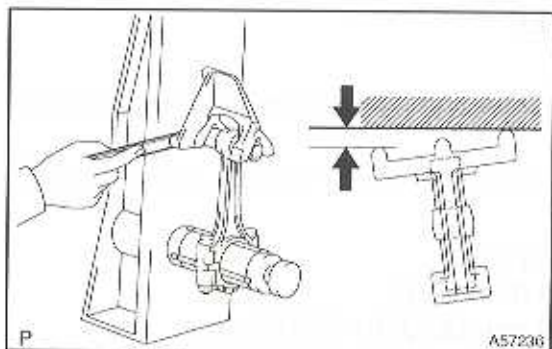
(a) Using a rod aligner and feeler gauge, check the connecting rod alignment.

(1) Check for bend.

Maximum bend:

0.05 mm (0.0020 in.) per 100 mm (3.94 in.)

If bend is greater than maximum, replace the connecting rod sub-assy.

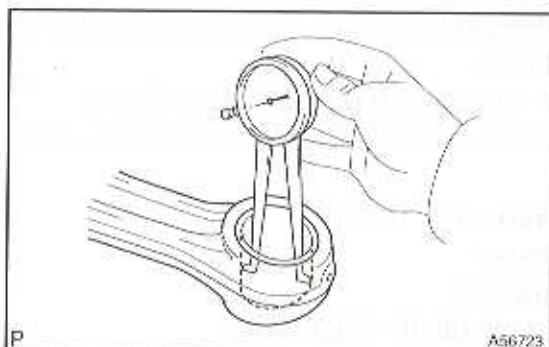


(2) Check for twist

Maximum twist:

0.15 mm (0.0059 in.) per 100 mm (3.94 in.)

If twist is greater than maximum, replace the connecting rod sub-assy.



21. INSPECT PISTON PIN OIL CLEARANCE

(a) Inspect the piston pin oil clearance.

(1) Using a caliper gauge, measure the inside diameter of the connecting rod bush.

Bush inside diameter:

29.008 – 29.020 mm (1.1420 – 1.1425 in.)

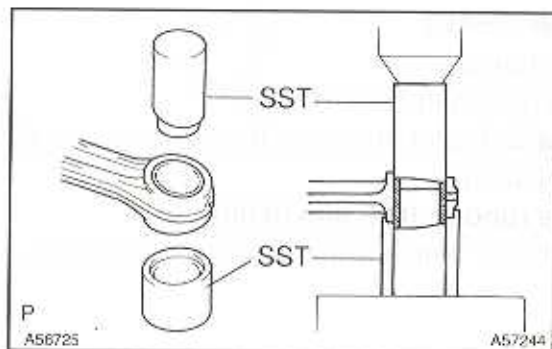
(2) Subtract the piston pin diameter measurement (See step 18) from the bush inside diameter measurement.

Standard oil clearance:

0.004 – 0.012 mm (0.0002 – 0.0005 in.)

Maximum oil clearance: 0.05 mm (0.0020 in.)

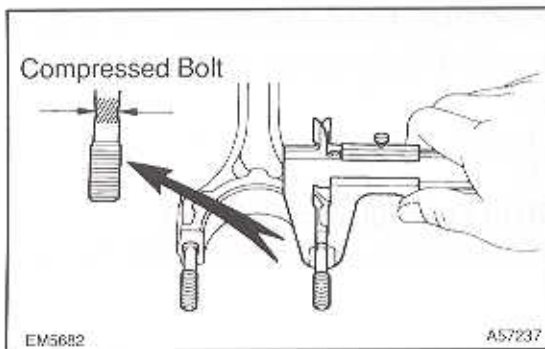
If the oil clearance is greater than maximum, replace the bush. If necessary, replace the piston and piston pin as a set.



22. REMOVE CONNECTING ROD SMALL END BUSH

(a) Using SST and a press, press out the bush.

SST 09222-54011 (09222-03016, 09222-03026)

**23. INSPECT CONNECTING ROD BOLT**

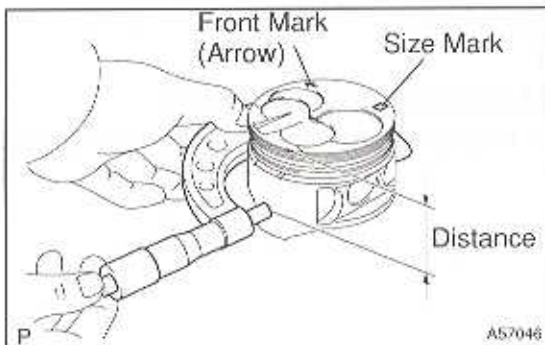
- (a) Using vernier calipers, measure the tension portion of the connecting rod bolt.

Standard diameter:

8.400 – 8.600 mm (0.3307 – 0.3386 in.)

Minimum diameter: 8.20 mm (0.3228 in.)

If the diameter is less than minimum, replace the bolt.

**24. BORE CYLINDER**

HINT:

- Bore all the 4 cylinders for the O/S piston outside diameter.
- Replace all the piston rings with ones to match the O/S pistons.

- (a) Keep 4 new O/S pistons.

O/S 0.50 piston diameter:

99.950 – 99.980 mm (3.9350 – 3.9362 in.)

- (b) Using a micrometer, measure the piston diameter at right angles to the piston pin center line, the indicated distance from the piston head.

Distance: 61.27 – 61.33 mm (2.4122 – 2.4146 in.)

- (c) Calculate the amount each cylinder is to be rebored as follows:

Size to be rebored = P + C – H

P = Piston diameter

C = Piston clearance:

0.040 – 0.060 mm (0.0016 – 0.0024 in.)

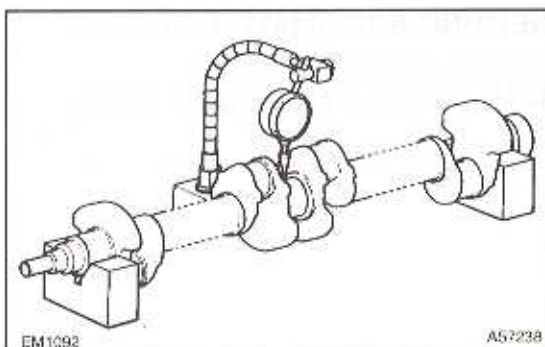
H = Allowance for honing: 0.02 mm (0.0008 in.) or less

- (d) Bore and hone the cylinders to calculated dimensions.

Maximum honing: 0.02 mm (0.0008 in.)

NOTICE:

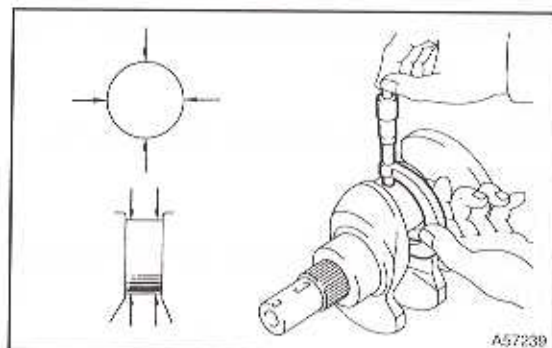
Excess honing will destroy the finished roundness.

**25. INSPECT CRANKSHAFT**

- (a) Inspect for circle runout.
- (1) Place the crankshaft on V-blocks.
 - (2) Using a dial indicator, measure the circle runout at the center journal.

Maximum circle runout: 0.06 mm (0.0024 in.)

If the circle runout is greater than maximum, replace the crankshaft.



- (b) Inspect the main journals and crank pins.
- (1) Using a micrometer, measure the diameter of each main journal and crank pin.

Main journal diameter:

STD	61.985 – 62.000 mm (2.4403 – 2.4409 in.)
U/S 0.25	61.745 – 61.755 mm (2.4309 – 2.4313 in.)
U/S 0.50	61.495 – 61.505 mm (2.4211 – 2.4215 in.)

Crank pin diameter:

STD	54.988 – 55.000 mm (2.1649 – 2.1654 in.)
U/S 0.25	54.745 – 54.755 mm (2.1553 – 2.1557 in.)
U/S 0.50	54.495 – 54.505 mm (2.1455 – 2.1459 in.)

If the diameter is not as specified, check the oil clearance (See steps 2 and 6). If necessary, grind or replace the crankshaft.

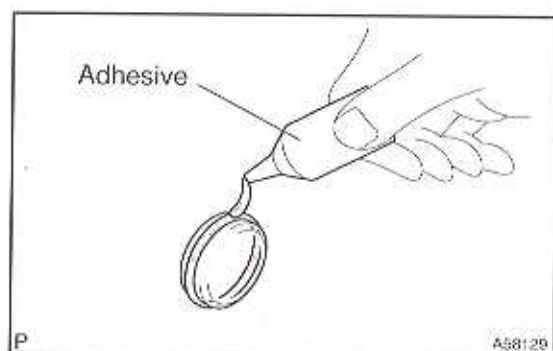
- (2) Check each main journal and crank pin for taper and out-of-round as shown.

Maximum taper and out-of-round:

0.02 mm (0.0008 in.)

If the taper and out-of-round is greater than maximum, replace the crankshaft.

- (c) If necessary, grind and hone the main journals and/or crank pins.
- (1) Grind and hone the main journals and/or crank pins to the finished undersized diameter (See procedure in step (b) above).
- (2) Install new main journal and/or crankshaft pin undersized bearing.

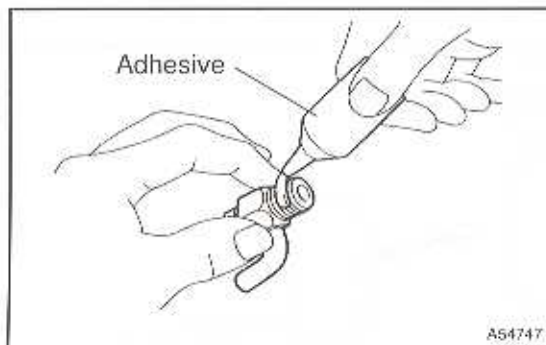


26. INSTALL TIGHT PLUG

- (a) Apply adhesive to a new tight plug.

Adhesive:

Part No. 08833-00070, THREE BOND 1324 or equivalent

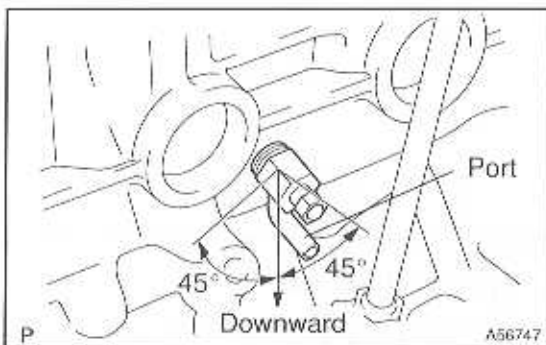


31. INSTALL CYLINDER BLOCK WATER DRAIN COCK SUB-ASSY

- (a) Apply adhesive to 2 or 3 threads.

Adhesive:

Part No. 08833-00070, THREE BOND 1324 or equivalent



- (b) Install the drain union.

Torque: 49 N·m (500 kgf·cm, 36 ft·lbf)

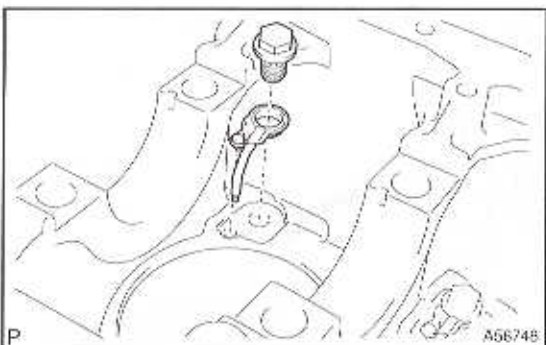
HINT:

- After applying the specified torque, rotate the drain union clockwise until its drain port is facing downward.
- The drain port may be set within 45° of either side of the prescribed position.

32. INSTALL CYLINDER BLOCK OIL ORIFICE

- (a) Using a 6 mm hexagon wrench, install the oil orifice.

Torque (Reference): 11 N·m (110 kgf·cm, 8 ft·lbf)

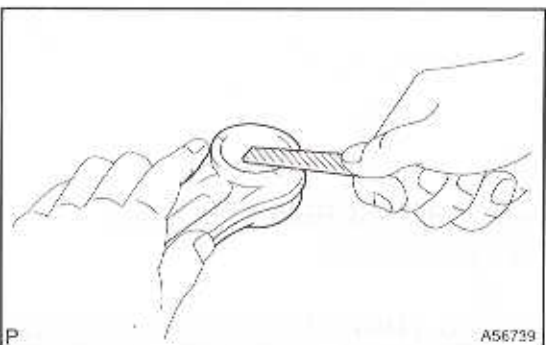


33. INSTALL SUB-ASSY OIL NOZZLE NO.1

- (a) Align the pin of the oil nozzle with the pin hole of the cylinder block.

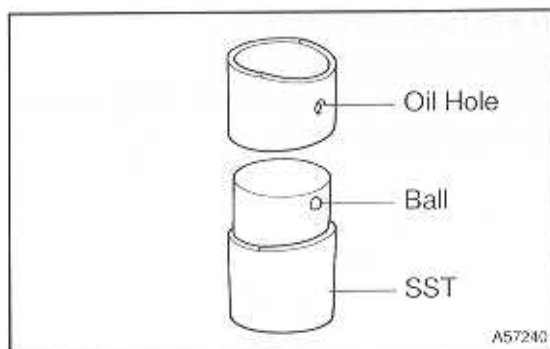
- (b) Install the oil nozzle with the check valve. Install the 4 oil nozzles and check valves.

Torque: 26 N·m (260 kgf·cm, 18 ft·lbf)



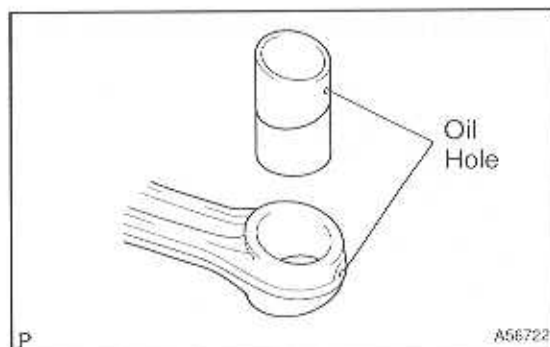
34. INSTALL CONNECTING ROD SMALL END BUSH

- (a) Using a round file, lightly file off any roughness from the small end of the connecting rod.

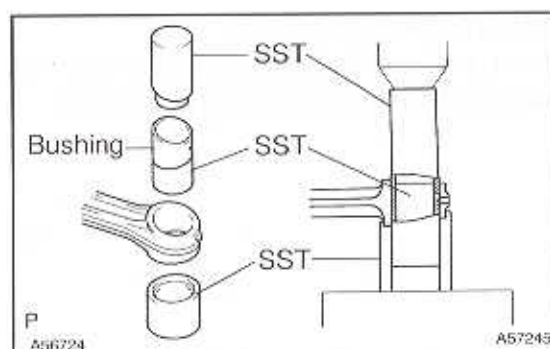


- (b) Attach a new bush to SST with the ball of SST inside the oil hole of the bush.

SST 09222-54011 (09222-03021)

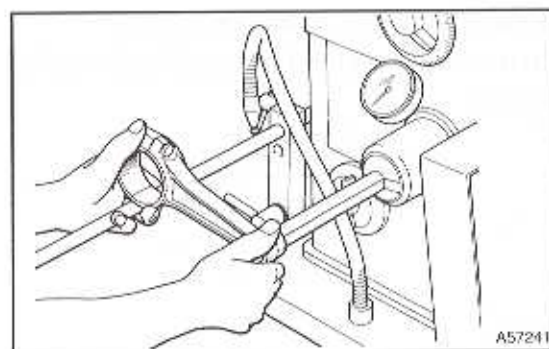


- (c) Align the oil holes of the bush and connecting rod.

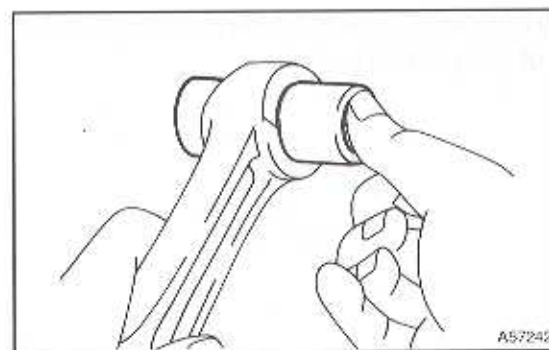


- (d) Using SST and a press, press in the bush.

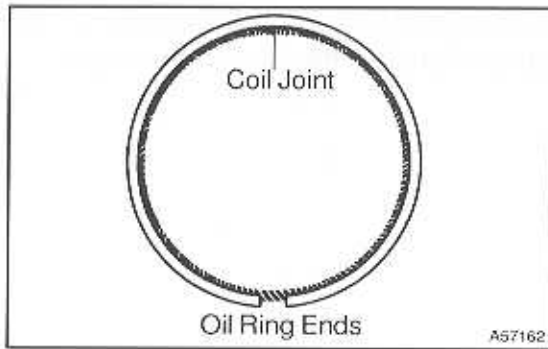
SST 09222-54011 (09222-03016, 09222-03021, 09222-03026)



- (e) Using a pin hole grinder, hone the bush to obtain the standard specified clearance (See step 21) between the bush and piston pin.



- (f) Check the piston pin fit at normal room temperature. Coat the piston pin with engine oil, and push it into the connecting rod with your thumb.

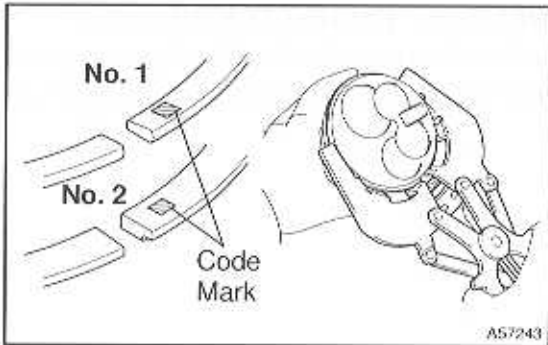


(b) Install the piston rings.

(1) Install the coil and oil ring by hand.

HINT:

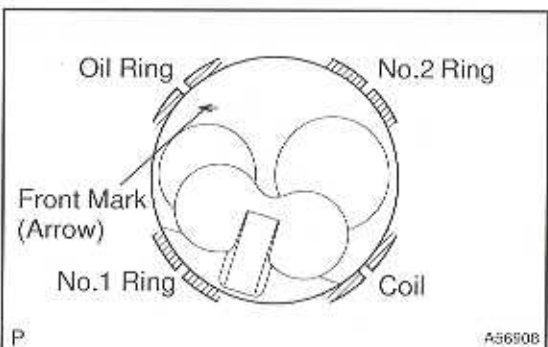
Face the end gap of the oil ring in the opposite direction coil joint.



(2) Using a piston ring expander, install the No. 1 and No. 2 piston rings with the code mark facing upward.

Code mark:

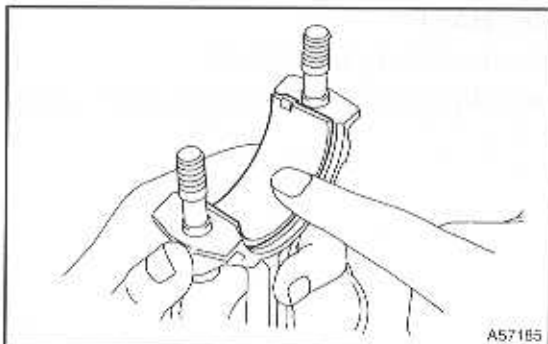
No. 1	1N
No. 2	2N



(3) Position the piston rings so that the ring ends are as shown.

NOTICE:

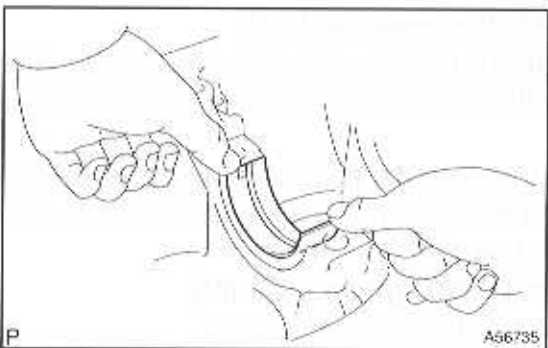
Do not align the ring ends.



36. INSTALL CONNECTING ROD BEARING

(a) Align the bearing claw with the groove of the connecting rod or connecting cap.

(b) Install the bearings in the connecting rod and connecting rod cap.

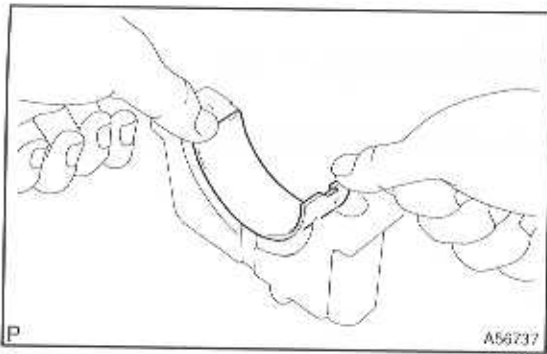


37. INSTALL CRANKSHAFT BEARING

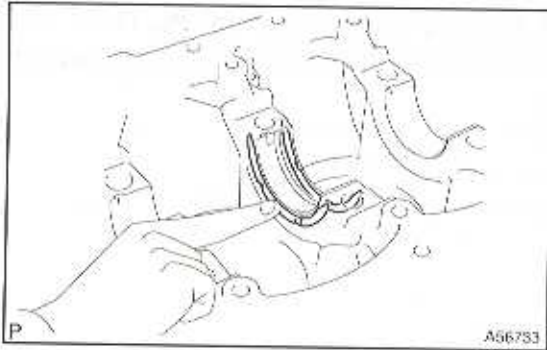
HINT:

Upper bearings have an oil groove and oil hole; lower bearings do not.

(a) Align the bearing claw with the claw groove of the cylinder block, and push in the 5 upper bearings.

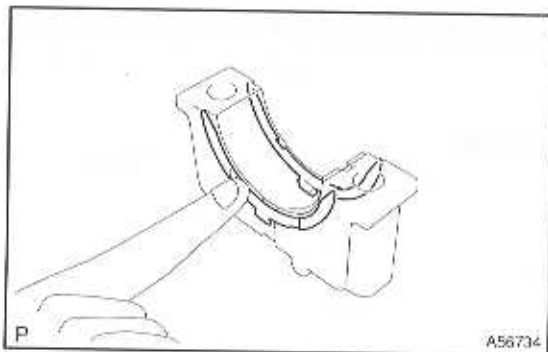


- (b) Align the bearing claw with the claw groove of the crankshaft bearing cap, and push in the 5 lower bearings.

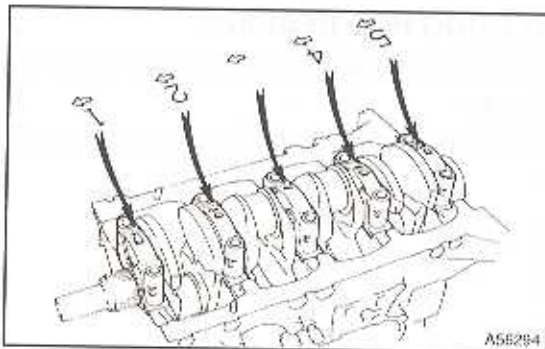


38. INSTALL CRANKSHAFT THRUST WASHER SET

- (a) Install the 2 thrust washers under the No. 3 journal position of the cylinder block with the oil grooves facing outward.

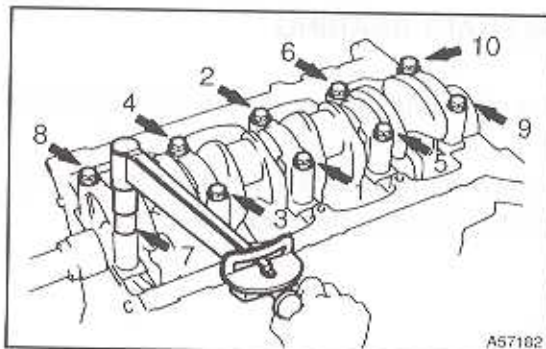


- (b) Install the 2 thrust washers on the No. 3 crankshaft bearing cap with the grooves facing outward.



39. INSTALL CRANKSHAFT

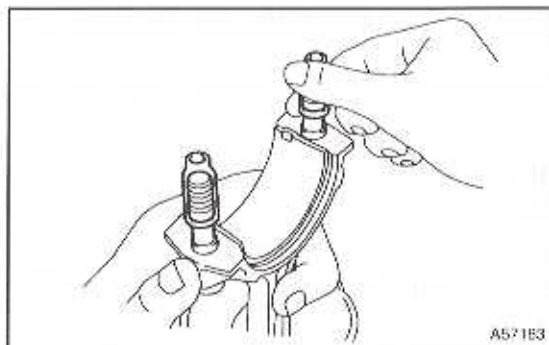
- (a) Place the crankshaft on the cylinder block.
 (b) Install the 5 crankshaft bearing caps in their proper locations.



- (c) Install the crankshaft bearing cap bolts.
 (1) Apply a light coat of the engine oil on the threads and under the bolt heads of the crankshaft bearing caps.
 (2) Install and uniformly tighten the 10 bolts of the crankshaft bearing caps, in several passes, in the sequence shown.

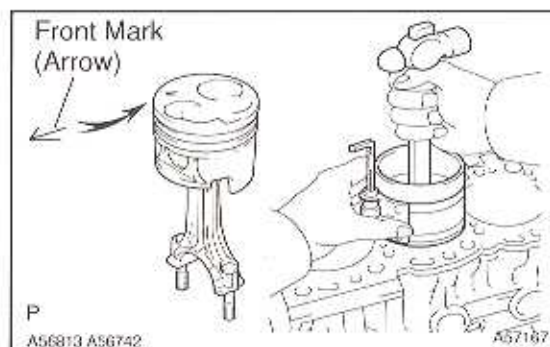
Torque: 105 N·m (1,050 kgf·cm, 77 ft·lbf)

- (d) Check that the crankshaft turns smoothly.
 (e) Check the crankshaft thrust clearance (See step 5).

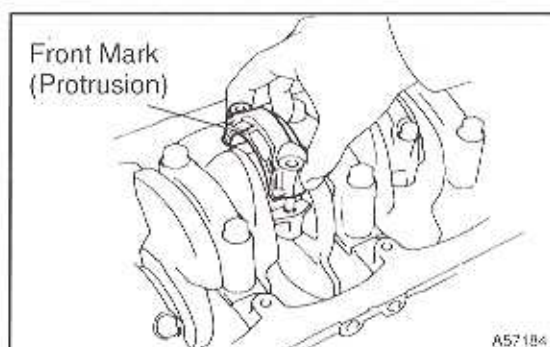


40. INSTALL PISTON AND CONNECTING ROD

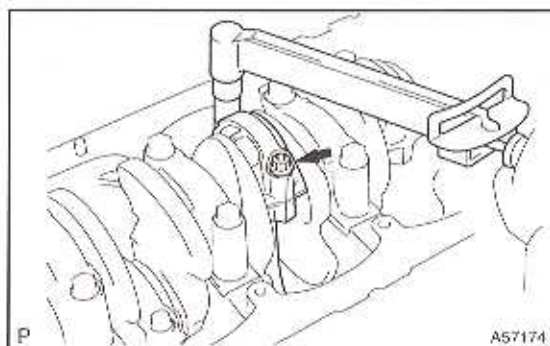
- (a) Cover the connecting rod bolts with a short piece of hose to protect the crankshaft and cylinder bore from damage.



- (b) Using a piston ring compressor, push the correctly numbered piston and connecting rod assembly into the cylinder with the front mark of the piston facing forward.



- (c) Place the connecting rod cap on the connecting rod.
- (1) Match the numbered connecting rod cap with the connecting rod.
 - (2) Install the connection rod cap with the front mark facing forward.



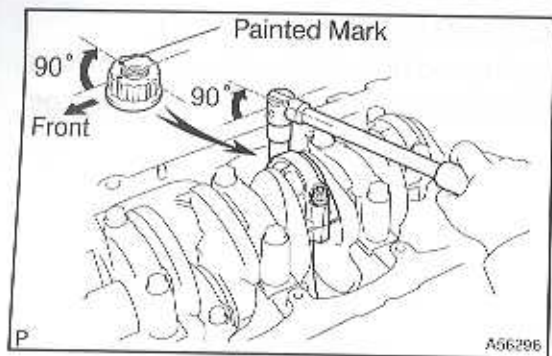
- (d) Install the connecting rod cap nuts.

HINT:

- The connecting rod cap nuts are tightened in 2 progressive steps (steps (2) and (4)).
 - If any connecting rod bolt is broken or deformed, replace it.
- (1) Apply a light of engine oil on the threads and under the heads of the connecting rod cap nuts.
 - (2) Install and alternately tighten the nuts of the connecting rod cap in several passes.

Torque: 54 N·m (550 kgf·cm, 40 ft·lbf)

If any one of the connecting rod cap nuts does not meet the torque specification, replace the cap nuts.

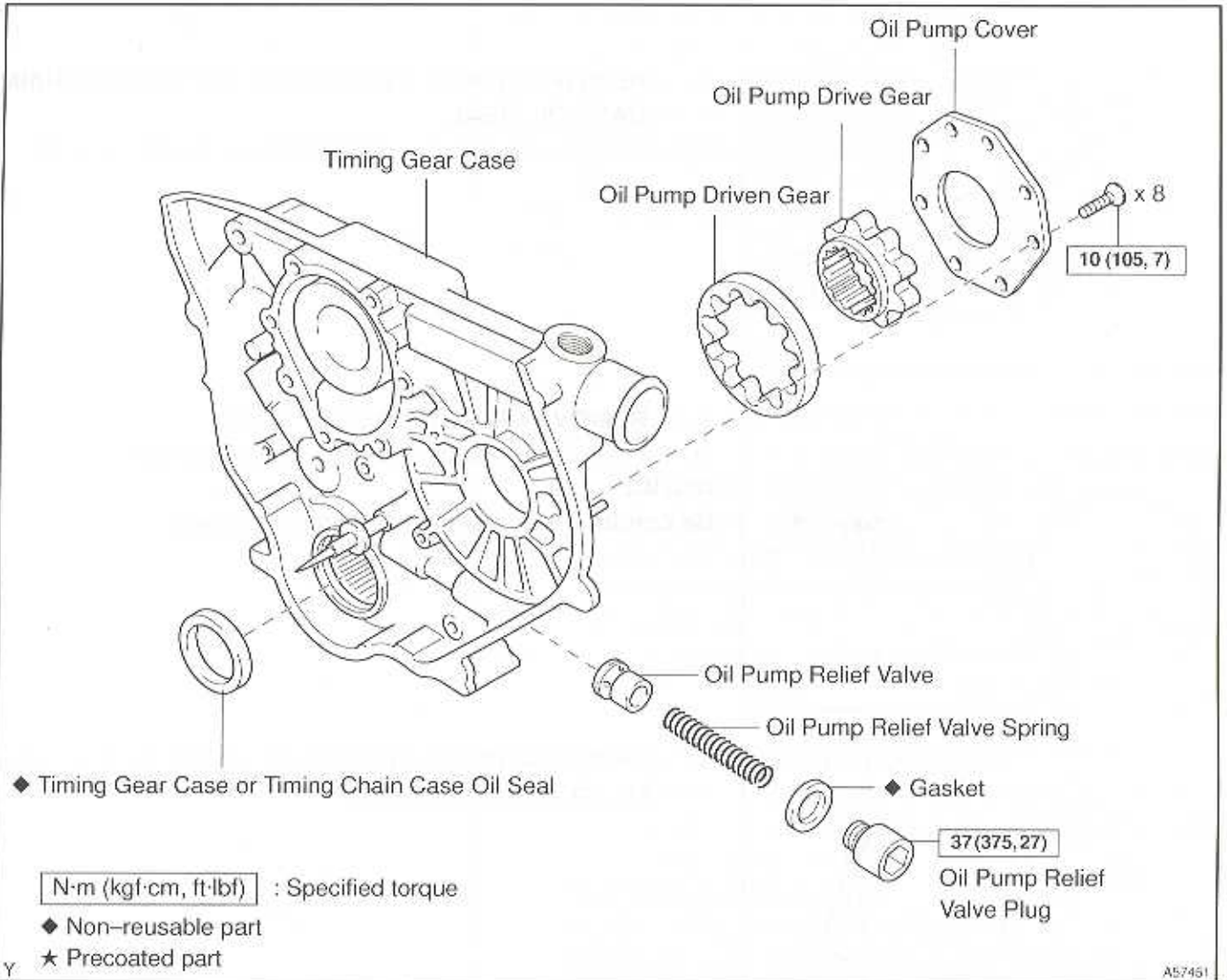


- (3) Mark the front of the connecting rod cap nuts with paint.
 - (4) Retighten the connecting rod cap nuts 90° as shown.
 - (5) Check that the painted mark is now at a 90° angle to the front.
- (e) Check that the crankshaft turns smoothly.
- (f) Check the connecting rod thrust clearance (See step 1).

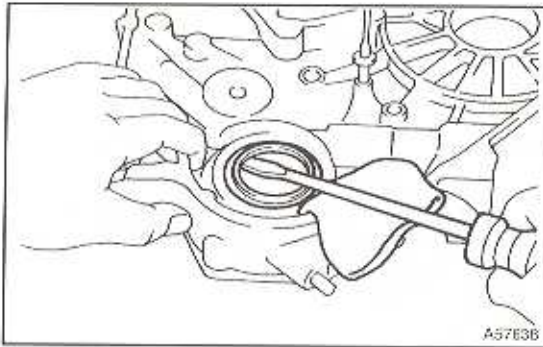
OIL PUMP ASSY (5L-E)

COMPONENTS

7599-0



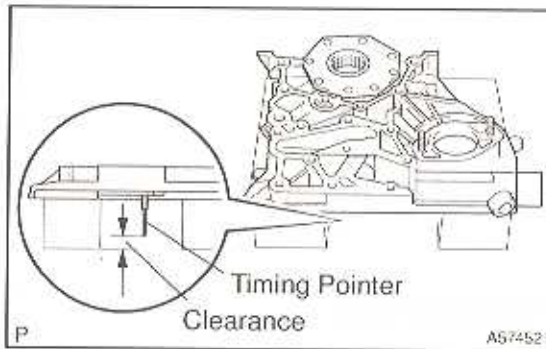
OVERHAUL



1. REMOVE TIMING GEAR CASE OR TIMING CHAIN CASE OIL SEAL

- (a) Using a screwdriver and hammer, tap out the oil seal.

17

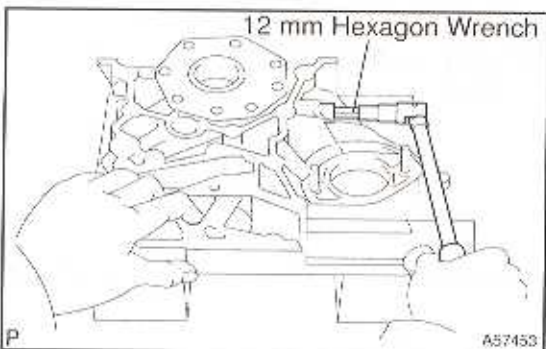


2. REMOVE OIL PUMP RELIEF VALVE

- (a) Place the timing belt case on wooden blocks.

NOTICE:

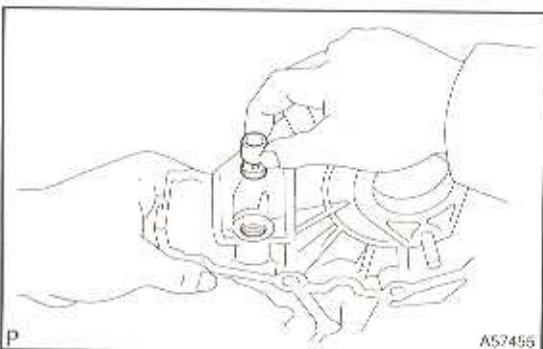
Be careful not to damage the timing pointer.



- (b) Using a 12 mm hexagon wrench, remove the plug, gasket, spring and relief valve.

3. REMOVE OIL PUMP DRIVE GEAR

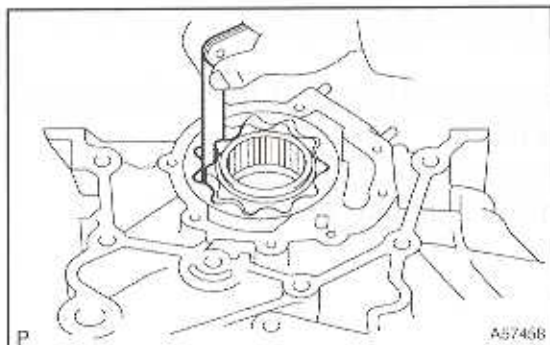
- (a) Remove the 8 screws, pump body cover, the drive and driven rotors.



4. INSPECT OIL PUMP RELIEF VALVE

- (a) Coat the valve with engine oil and check that it falls smoothly into the valve hole by its own weight.

If it doesn't, replace the relief valve. If necessary, replace the oil pump assembly.



5. INSPECT OIL PUMP DRIVE GEAR

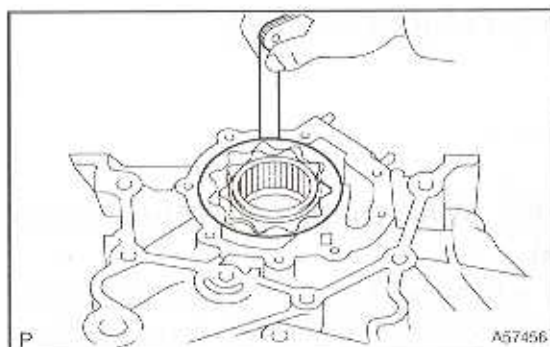
- (a) Insert the drive and driven rotors into timing belt case with the marks facing the pump body cover side (See step 6).
- (b) Inspect the rotor tip clearance.
 - (1) Using a feeler gauge, measure the clearance between the drive and driven rotor tips.

Standard tip clearance:

0.110 – 0.240 mm (0.0043 – 0.0094 in.)

Maximum tip clearance: 0.30 mm (0.0118 in.)

If the tip clearance is greater than maximum, replace the rotors as set.



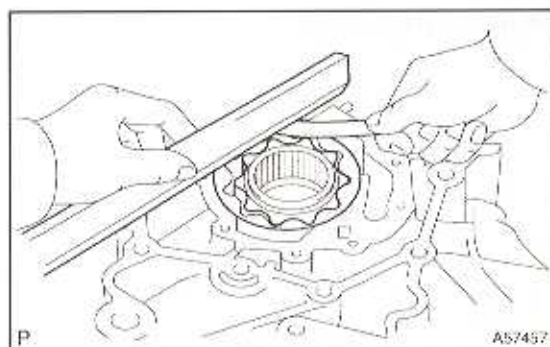
- (c) Inspect the rotor body clearance.
 - (1) Using a feeler gauge, measure the clearance between the driven rotor and gear case.

Standard body clearance:

0.144 – 0.219 mm (0.0057 – 0.0086 in.)

Maximum body clearance: 0.40 mm (0.0157 in.)

If the body clearance is greater than maximum, replace the rotors as set. If necessary, replace the oil pump assembly.



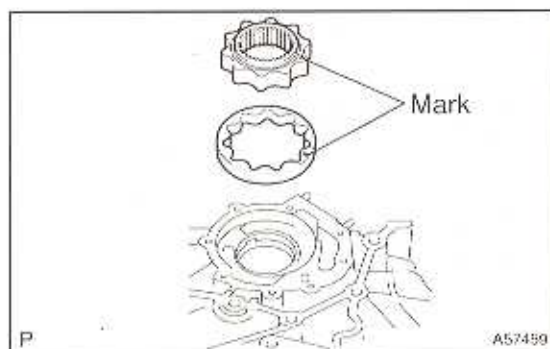
- (d) Inspect the rotor side clearance.
 - (1) Using a feeler gauge and precision straight edge, measure the clearance between the rotors and precision straight edge.

Standard side clearance:

0.035 – 0.085 mm (0.014 – 0.0033 in.)

Maximum side clearance: 0.15 mm (0.0059 in.)

If the side clearance is greater than maximum, replace the rotors as set. If necessary, replace the oil pump assembly.



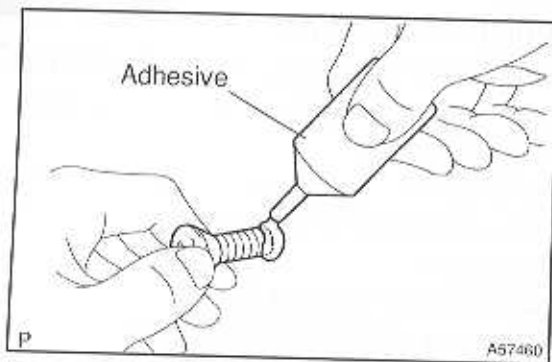
6. INSTALL OIL PUMP DRIVE GEAR

- (a) Place the timing belt case on wooden blocks (See step 2).

NOTICE:

Be careful not to damage the timing pointer.

- (b) Insert the drive and driven rotors into timing belt case with the marks facing the oil pump cover side.



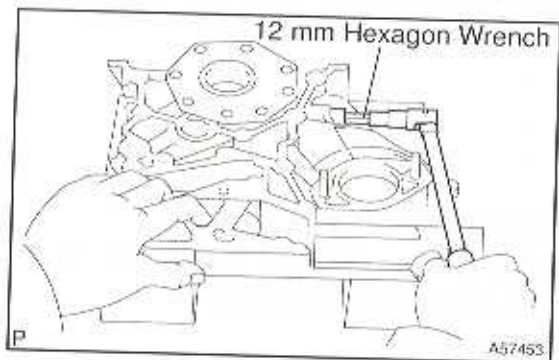
- (c) Apply adhesive to 2 or 3 threads of the screws.

Adhesive:

Part No. 08833-00080, THREE BOND 1344 LOCTITE 242 or equivalent

- (d) Install the oil pump cover with the 8 screws.

Torque: 10 N·m (105 kgf·cm, 7 ft·lbf)

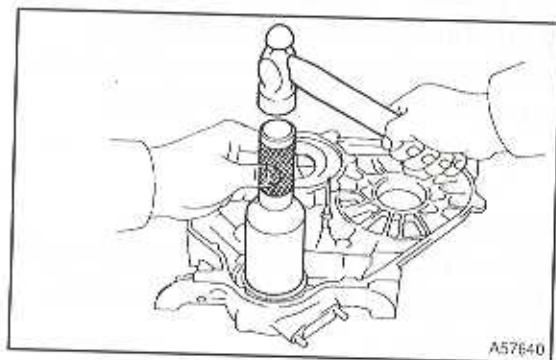


7. INSTALL OIL PUMP RELIEF VALVE

- (a) Insert the relief valve and spring into the installation hole of the timing belt case.

- (b) Using a 12 mm hexagon wrench, install a new gasket and the plug.

Torque: 37 N·m (375 kgf·cm, 27 ft·lbf)



8. INSTALL TIMING GEAR CASE OR TIMING CHAIN CASE OIL SEAL

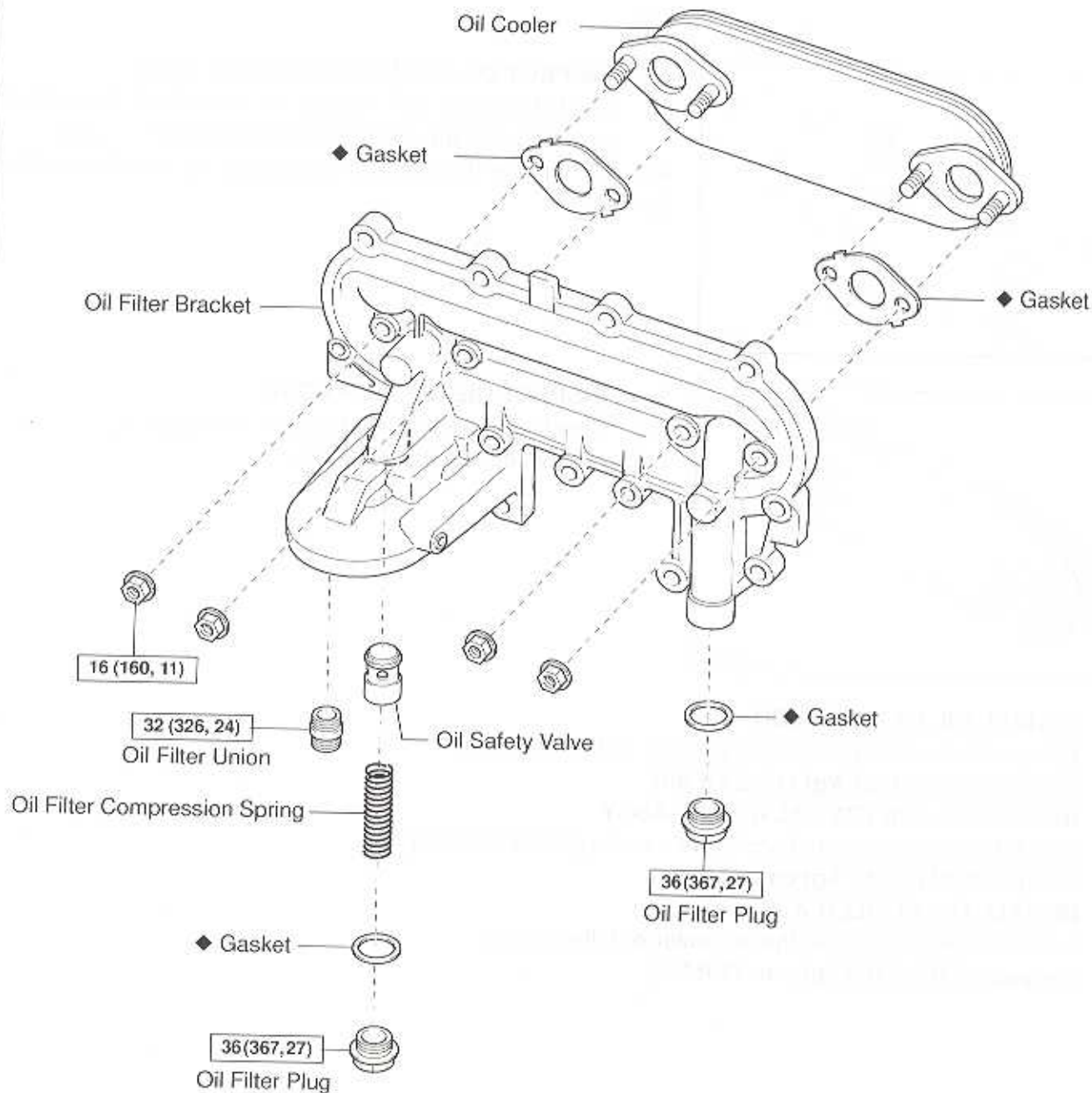
- (a) Using SST and a hammer, tap in a new oil seal to the depth of 0.5 mm (0.020 in.) from the oil pump case edge.
SST 09214-60010

- (b) Apply MP grease to the oil seal lip.

OIL COOLER ASSY (5L-E) COMPONENTS

13099-0

17
15



N·m (kgf·cm, ft·lbf) : Specified torque

◆ Non-reusable part

OVERHAUL

1. REMOVE OIL COOLER ASSY

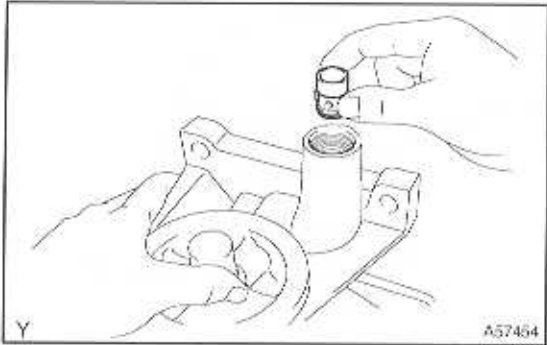
- (a) Remove the 4 nuts, oil cooler and 2 gaskets.

2. REMOVE OIL SAFETY VALVE SUB-ASSY

- (a) Remove the plug, gasket, spring and safety valve.

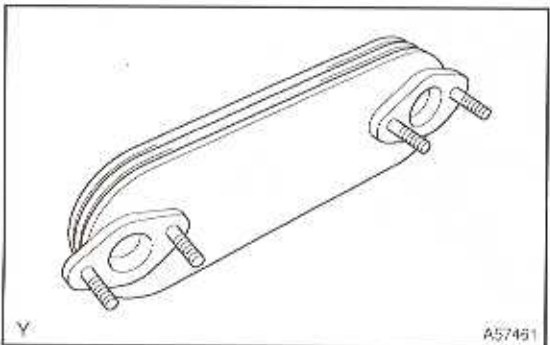
3. REMOVE OIL FILTER UNION

- (a) Using a 12 mm socket hexagon wrench, remove the union.



4. INSPECT OIL SAFETY VALVE SUB-ASSY

- (a) Coat the valve with engine oil and check that it falls smoothly into the oil filter bracket by its own weight. If it is not, replace the valve. If necessary, replace the oil filter bracket.



5. INSPECT OIL COOLER ASSY

- (a) Check the oil cooler for damage or clogging. If necessary, replace the oil cooler.

6. INSTALL OIL FILTER UNION

- (a) Using a 12 mm socket hexagon wrench, install the union.

Torque: 32 N·m (326 kgf·cm, 24 ft·lbf)

7. INSTALL OIL SAFETY VALVE SUB-ASSY

- (a) Install the safety valve and spring with a new gasket and the plug.

Torque: 36 N·m (367 kgf·cm, 27 ft·lbf)

8. INSTALL OIL COOLER ASSY

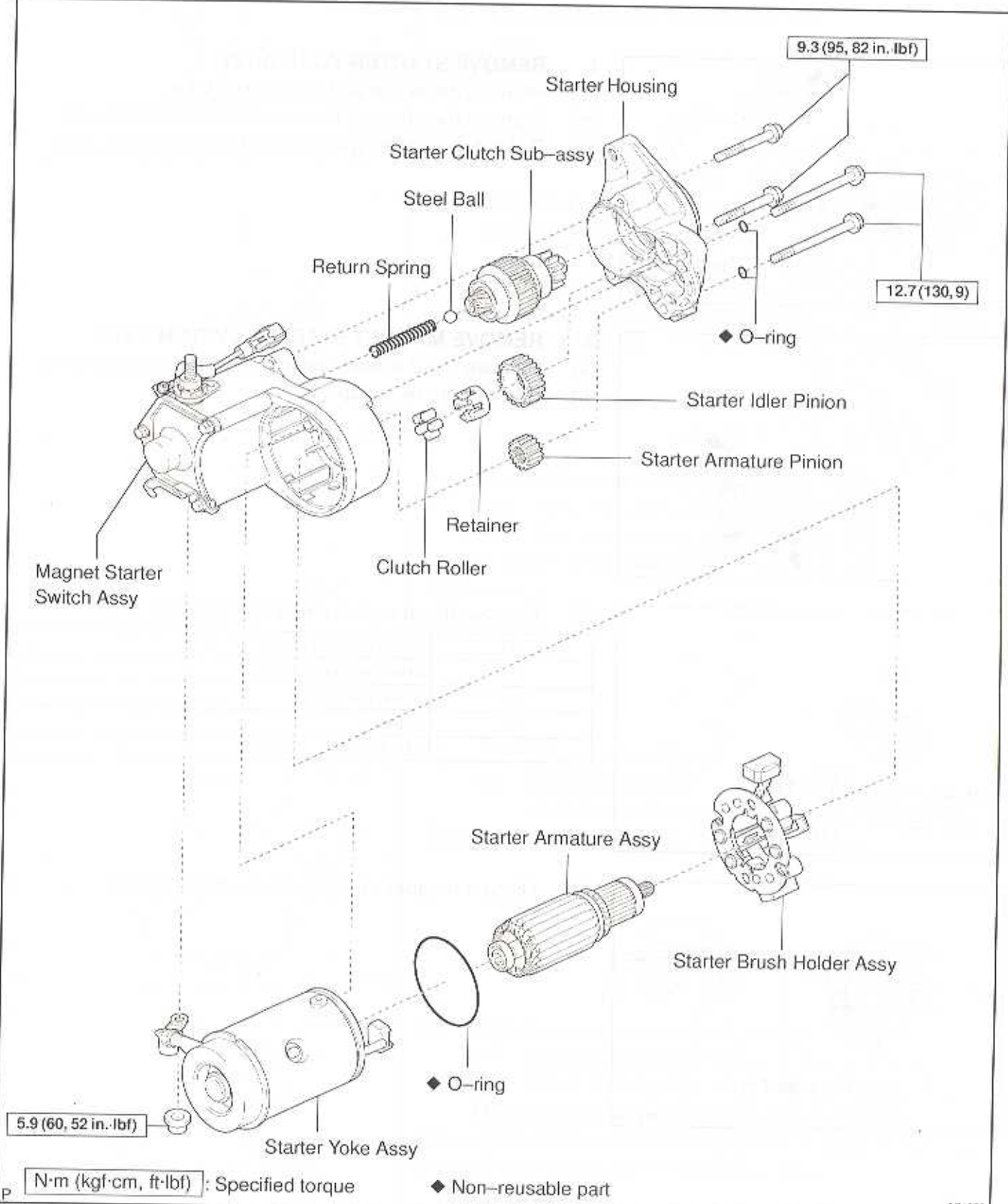
- (a) Install 2 new gaskets and the oil cooler with the 4 nuts.

Torque: 16 N·m (160 kgf·cm, 11 ft·lbf)

STARTER ASSY (5L-E) COMPONENTS

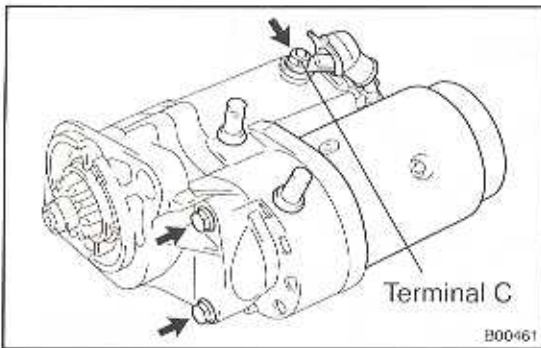
651J-91

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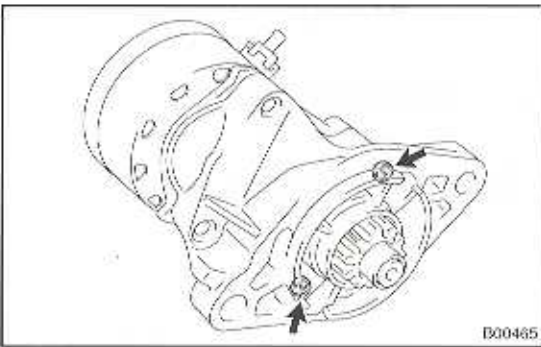


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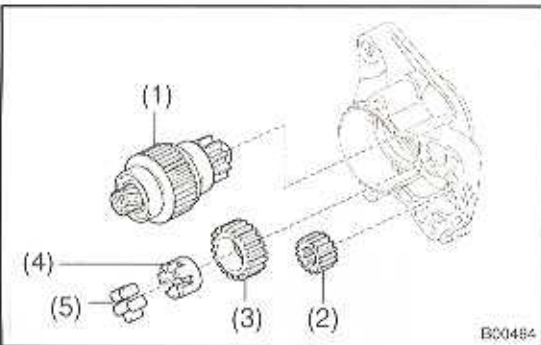
OVERHAUL

**1. REMOVE STARTER YOKE ASSY**

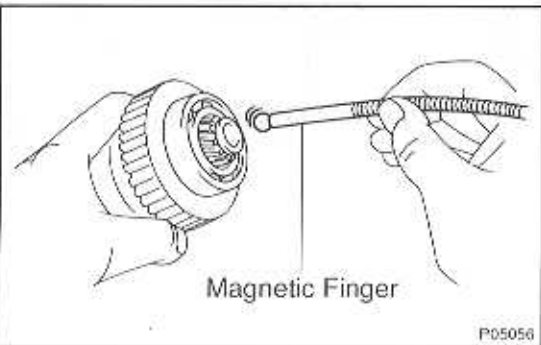
- (a) Remove the screw and terminal 50 wire.
- (b) Remove the nut and disconnect the terminal C wire.
- (c) Pull out the starter yoke assy with the armature assy.

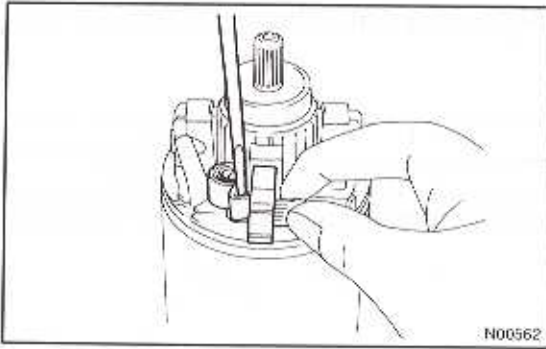
**2. REMOVE MAGNET STARTER SWITCH ASSY**

- (a) Remove the 2 screws and magnet starter switch assy.
- (b) Remove the return spring.

**(c) Remove these parts from starter housing.**

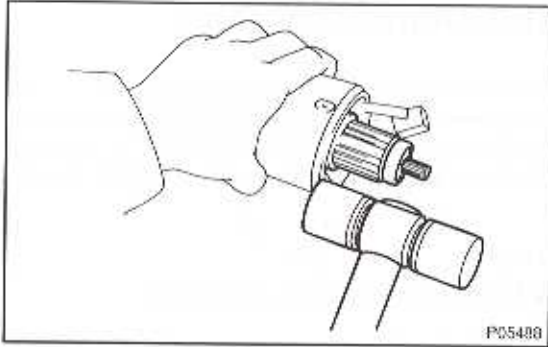
(1)	Starter clutch sub-assy
(2)	Starter armature pinion
(3)	Starter idler pinion
(4)	Retainer
(5)	Clutch roller

**(d) Using a magnetic finger, remove the steel ball.**



3. REMOVE STARTER BRUSH HOLDER ASSY

- (a) Using a screwdriver, hold the spring back and disconnect the brush.
- (b) Disconnect the 4 brushes and remove the brush holder assy.

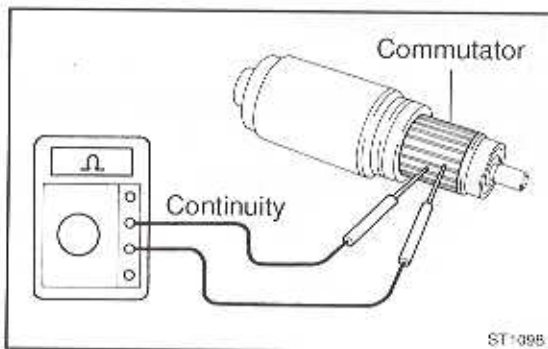


4. REMOVE STARTER ARMATURE ASSY

- (a) Using a plastic-faced hammer, tap the end of starter yoke assy and remove the armature assy.

5. INSPECT STARTER ARMATURE ASSY

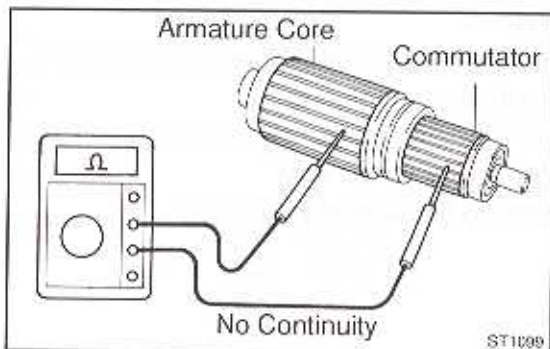
If the surface of the commutator is dirty or burned, polish the part with sandpaper (#400) or replace the armature.



- (a) Check the commutator open circuit.

- (1) Using an ohmmeter, check that there is continuity between the segments of the commutator.

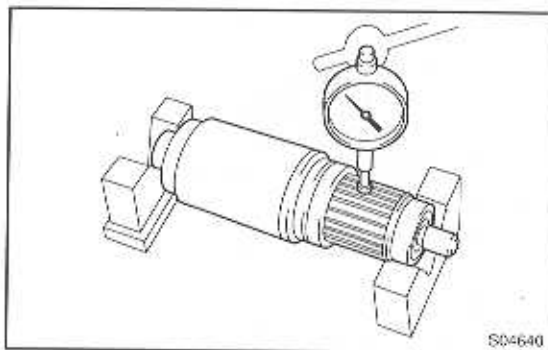
If there is no continuity between any segment, replace the armature assy.



- (b) Check the commutator ground.

- (1) Using an ohmmeter, check that there is no continuity between the commutator and armature core.

If there is continuity, replace the armature assy.

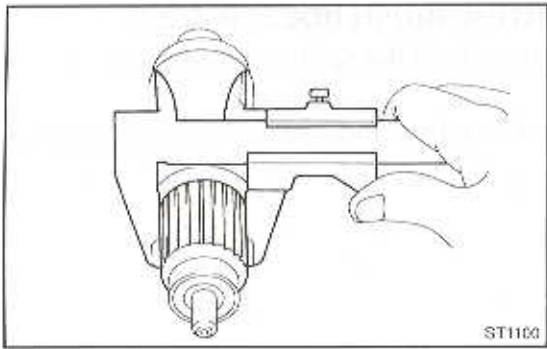


- (c) Check the commutator circle runout.

- (1) Place the armature on the V-blocks.
- (2) Using a dial gauge, measure the circle runout.

Maximum circle runout: 0.05 mm (0.0020 in.)

If the circle runout is greater than maximum, correct it with sandpaper (#400) or replace the armature assy.

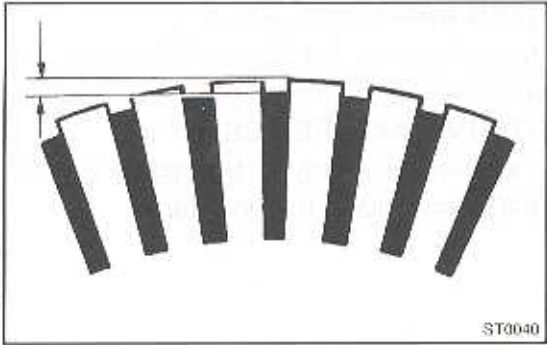


- (d) Using vernier calipers, measure the commutator diameter.

Diameter:

Standard	35.0 mm (1.378 in.)
Minimum	34.0 mm (1.339 in.)

If the diameter is less than the minimum, replace the armature assy.



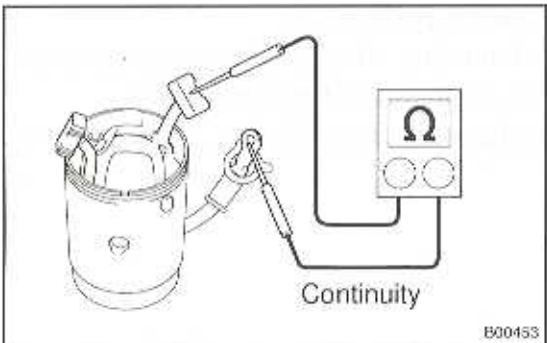
- (e) Measure the undercut depth of commutator.

Depth:

Standard	0.7 mm (0.028 in.)
Minimum	0.2 mm (0.008 in.)

If the undercut depth is less than the minimum, correct it with a hacksaw blade.

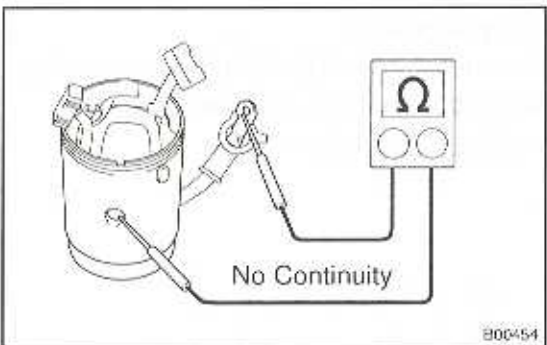
- (f) Inspect the bearings.
 (1) Check that the bearing rotates smoothly.
 If necessary, replace them.



6. INSPECT STARTER YOKE ASSY

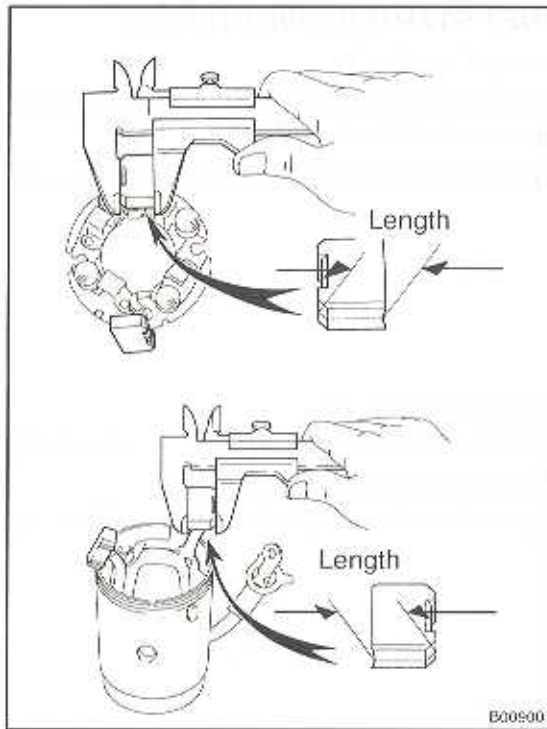
- (a) Inspect for open circuit.
 (1) Check that there is continuity between the terminal C wire and brushes.

If there is no continuity, replace the starter yoke.



- (b) Inspect for ground.
 (1) Check that there is no continuity between the terminal C wire and starter yoke body.
 (2) Check that there is no continuity between the brushes and starter yoke body.

If there is continuity, replace the starter yoke assy.



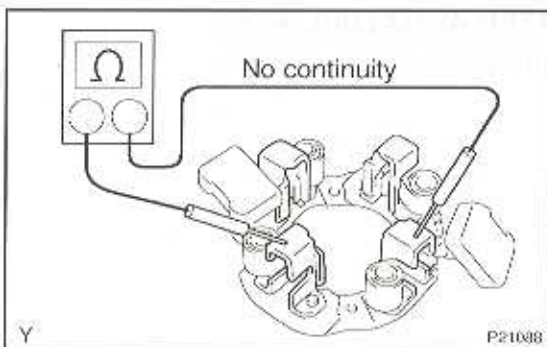
7. INSPECT BRUSH

- (a) Using vernier calipers, measure the brush length.

Brush length:

Standard	16.5 mm (0.650 in.)
Minimum	9.0 mm (0.354 in.)

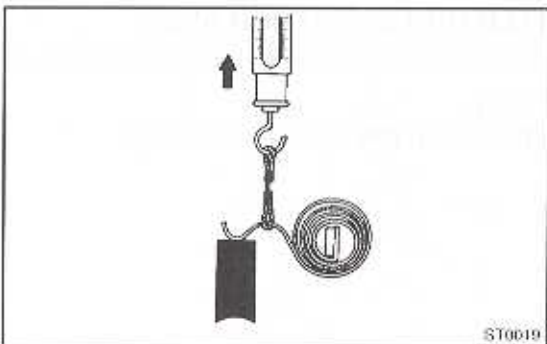
If the length is less than the minimum, replace the brush holder and starter yoke assy.



8. INSPECT STARTER BRUSH HOLDER ASSY

- (a) Using an ohmmeter, check that there is no continuity between the positive and negative brush holders.

If there is continuity, replace the brush holder.



- (b) Using a pull scale, measure the brush spring load.

Spring load:

Standard	26.5 – 32.3 N (2.7 – 3.3 kgf, 6.0 – 7.3 lbf)
Minimum	17.6 N (1.8 kgf, 4.0 lbf)

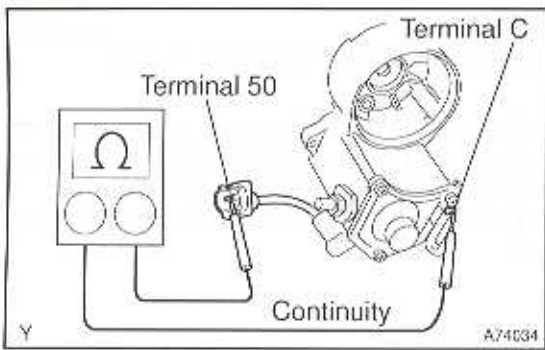
If the spring load is less than the minimum, replace the brush springs.



9. INSPECT STARTER CLUTCH SUB-ASSY

- (a) Check that the starter clutch operates.

If the starter clutch does not operate, replace it.

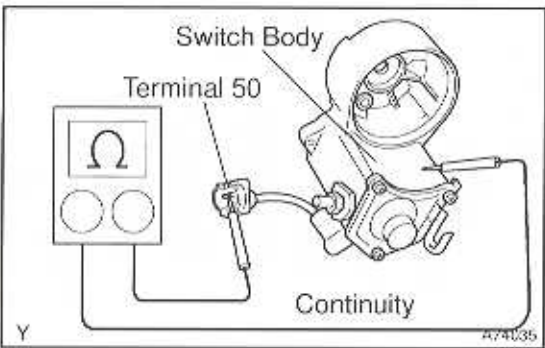


10. INSPECT MAGNET STARTER SWITCH ASSY

(a) Check the pull-in coil continuity.

- (1) Using an ohmmeter, check that there is continuity between terminals 50 and C.

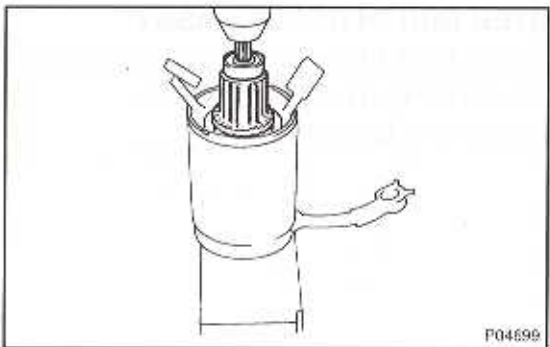
If there is no continuity, replace the magnet starter switch assy.



(b) Check the holding coil continuity.

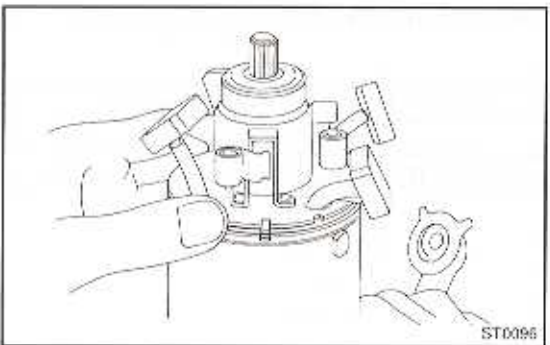
- (1) Using an ohmmeter, check that there is continuity between terminals 50 and switch body.

If there is no continuity, replace the magnet starter switch assy.



11. INSTALL STARTER ARMATURE ASSY

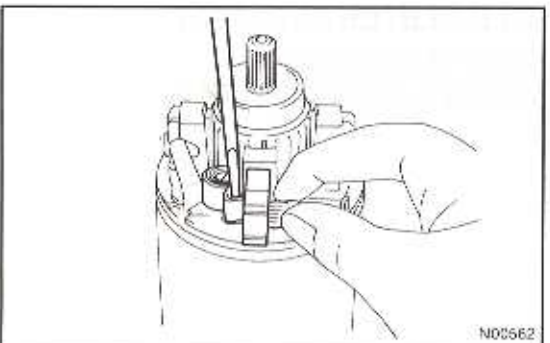
(a) Using a press, install the armature assy.



12. INSTALL STARTER BRUSH HOLDER ASSY

(a) Align the claw of the brush holder with the claw groove of the starter yoke assy.

(b) Place the brush holder on the starter yoke assy.



(c) Using a screwdriver, hold the brush spring back.

(d) Connect the brush into the brush holder.

(e) Connect the 4 brushes.

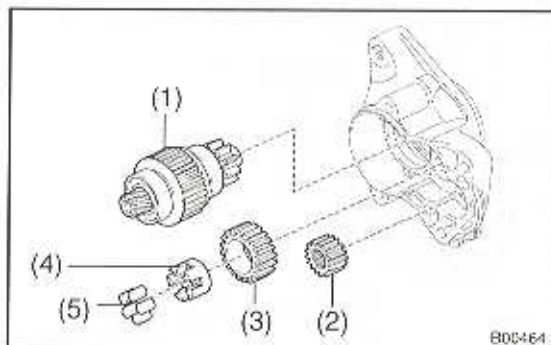
NOTICE:

Check that the positive (+) lead wires are not grounded.

(f) Install a new O-ring to the groove of the starter yoke.

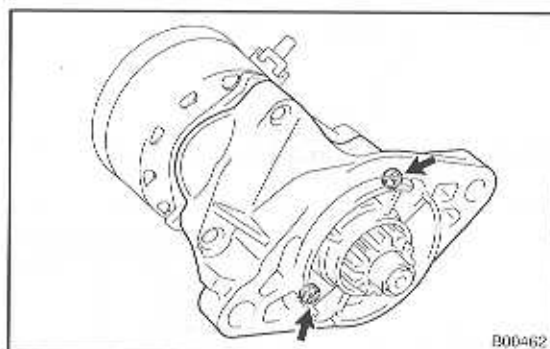
13. INSTALL MAGNET STARTER SWITCH ASSY

- (a) Apply grease to the steel ball, return spring.
- (b) Install the steel ball into the magnet starter switch hole.
- (c) Insert the return spring into the magnet starter switch hole.



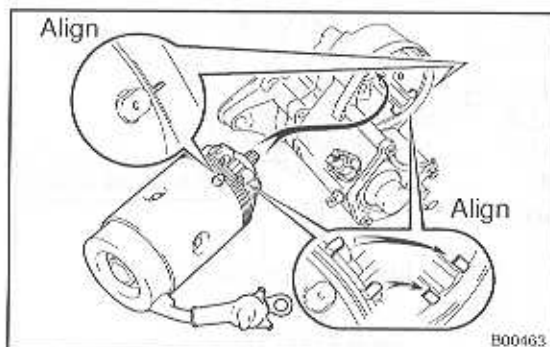
- (d) Place these parts in position on the starter housing.

(1)	Starter clutch sub-assy
(2)	Starter armature pinion
(3)	Starter idler pinion
(4)	Retainer
(5)	Clutch roller

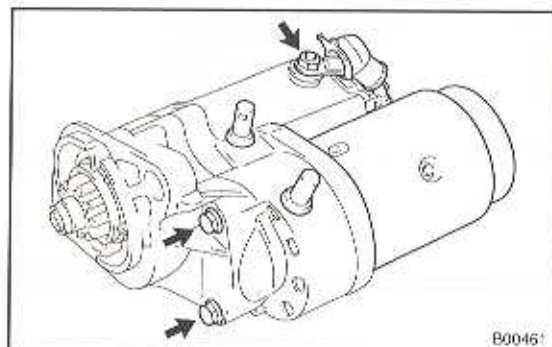


- (e) Install the starter housing to the magnet magnet switch assy with the 2 screws.

Torque: 9.3 N-m (95 kgf-cm, 82 in.-lbf)

**14. INSTALL STARTER YOKE ASSY**

- (a) Install a new O-ring to the groove of the through bolt.
- (b) Align the claws of the brush holder with the grooves of the magnet starter switch.
- (c) Install the starter yoke assy with the armature assy.
- (d) Align the punch mark of the starter yoke with the line of the magnet starter switch.



- (e) Install a new O-ring to the through bolt.
- (f) Install the 2 long bolts.

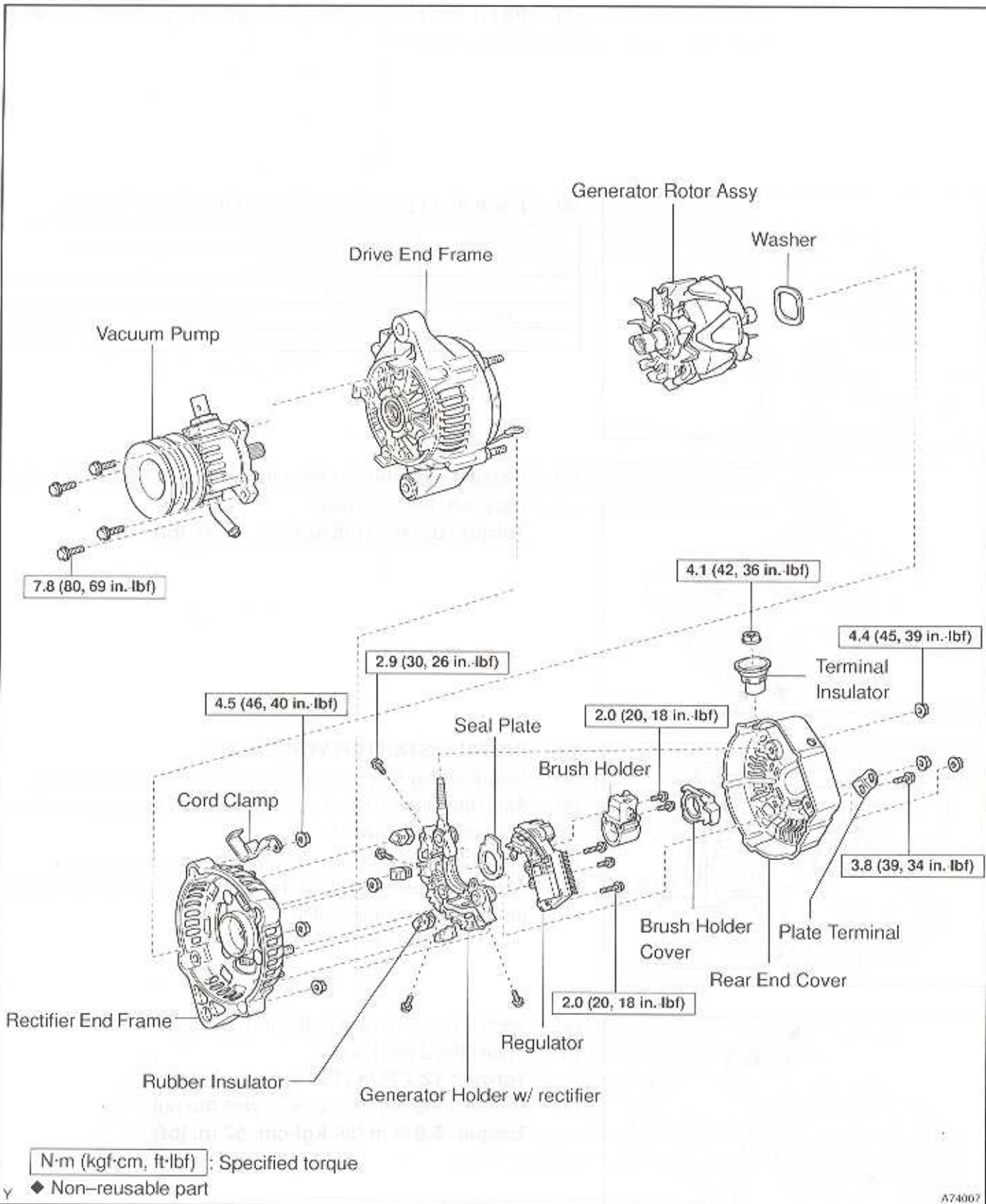
Torque: 12.7 N-m (130 kgf-cm, 9 ft-lbf)

- (g) Connect the terminal C wire with the nut.
- Torque: 5.9 N-m (60 kgf-cm, 52 in.-lbf)**

GENERATOR ASSY (5L-E)

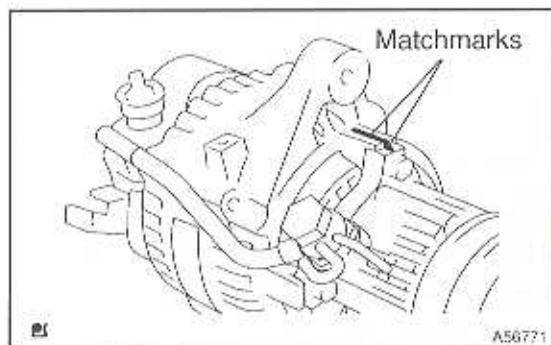
COMPONENTS

9919-0

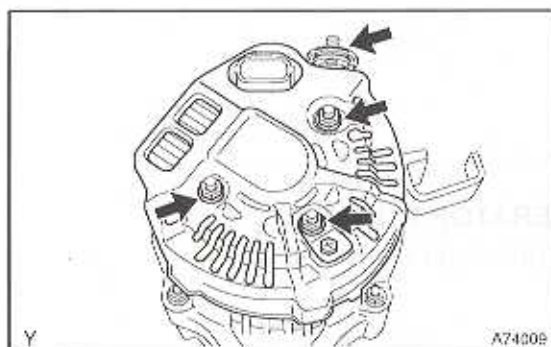


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OVERHAUL

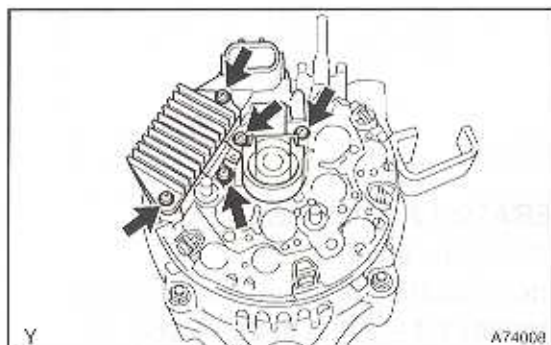
**1. REMOVE VACUUM PUMP ASSY**

- (a) Place the matchmarks as shown.
- (b) Remove the 4 bolts and vacuum pump assy.

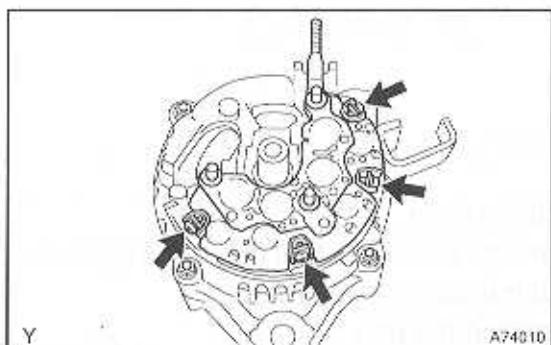
**2. REMOVE REAR END COVER**

- (a) Remove the nut and terminal insulator.
- (b) Remove the bolt, 3 nuts, plate terminal and rear end cover.

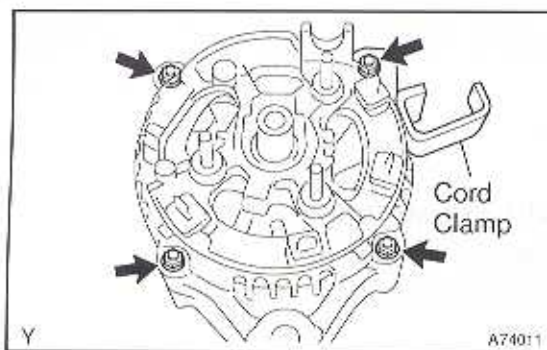
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**3. REMOVE GENERATOR BRUSH HOLDER AND GENERATOR REGULATOR**

- (a) Remove the brush holder cover.
- (b) Remove the 2 screws and brush holder assy.
- (c) Remove the seal plate.
- (d) Remove the 3 screws and regulator assy.

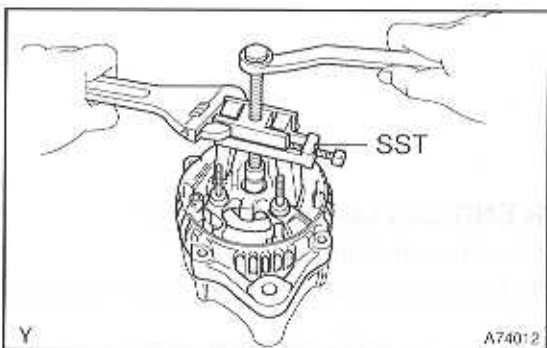
**4. REMOVE GENERATOR HOLDER W/RECTIFIER**

- (a) Remove the 4 screws and rectifier holder.
- (b) Remove the 4 rubber insulators.



5. REMOVE RECTIFIER END FRAME

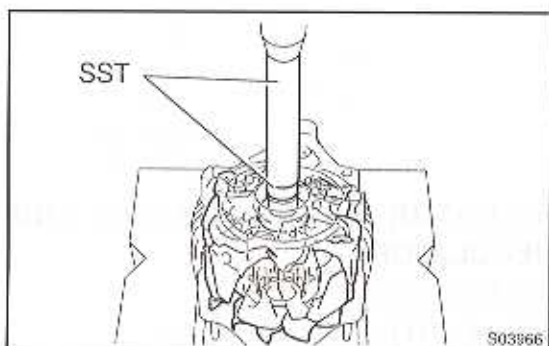
(a) Remove the 4 nuts and cord clamp.



(b) Using SST, remove the rectifier end frame.

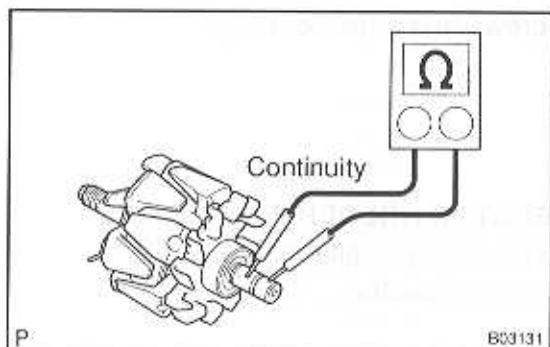
SST 09286-46011

(c) Remove the generator washer from the rotor.



6. REMOVE GENERATOR ROTOR ASSY

(a) Using SST and press, press out the rotor.



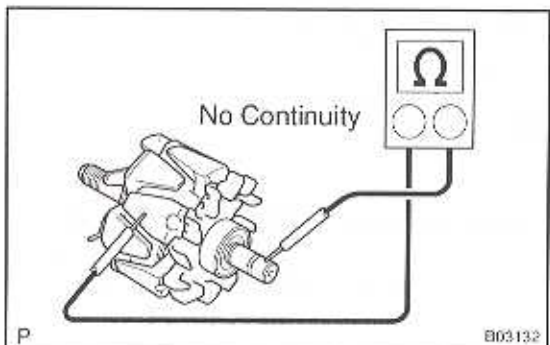
7. INSPECT GENERATOR ROTOR ASSY

(a) Check the rotor for open circuit.

(1) Measure the resistance between the slip rings.

Standard resistance: 2.1 – 2.5 Ω at 20 °C (68 °F)

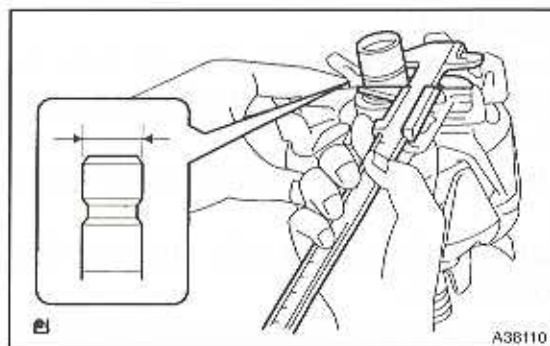
If there is no continuity, replace the rotor.



(b) Check the rotor for ground.

(1) Using an ohmmeter, check that there is no continuity between the slip ring and rotor.

If there is continuity, replace the rotor.

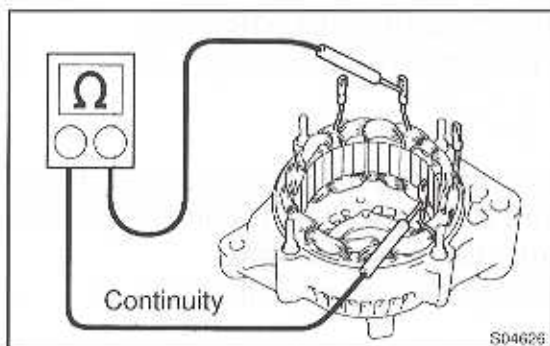


- (c) Check that the slip rings are not rough or scored.
If rough or scored, replace the rotor.
- (d) Using vernier calipers, measure the slip ring diameter.
Standard diameter: 14.2 – 14.4 mm (0.559 – 0.567 in.)
Minimum diameter: 12.8 mm (0.504 in.)

If the diameter is less than the minimum, replace the rotor.

- (e) Inspect the bearing.
(1) Inspect the bearing is not rough or worn.

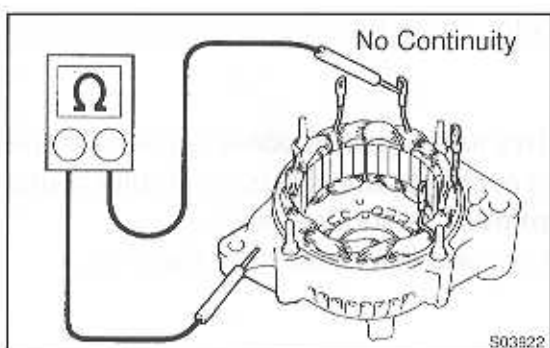
If necessary, replace the generator rotor.



8. INSPECT DRIVE END FRAME

- (a) Check the stator for open circuit.
(1) Using an ohmmeter, check that there is continuity between the coil leads.

If there is no continuity, replace the drive end frame assembly.

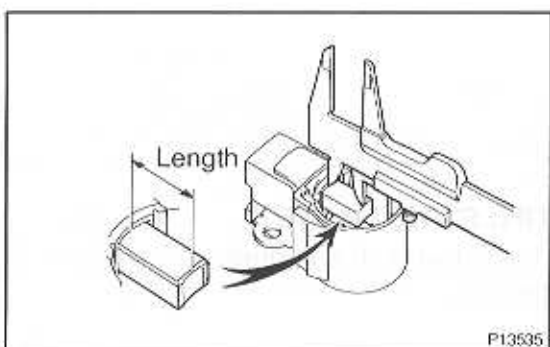


- (b) Check the stator for ground.
(1) Using an ohmmeter, check that there is no continuity between the coil lead and drive end frame.

If there is continuity, replace the drive end frame assembly.

- (c) Inspect the bearing.
(1) Inspect the bearing is not rough or worn.

If necessary, replace the generator assy.

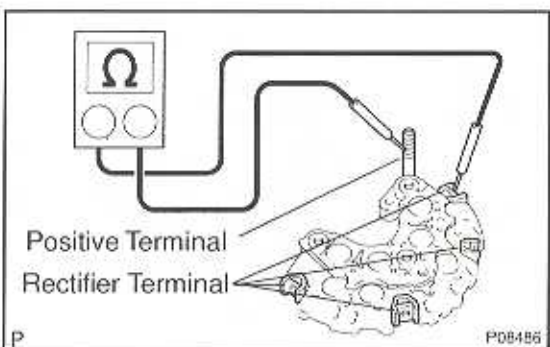


9. INSPECT GENERATOR BRUSH HOLDER ASSY

- (a) Using vernier calipers, measure the exposed brush length.

**Standard exposed length:
9.5 – 11.5 mm (0.374 – 0.453 in.)**
Minimum exposed length: 1.5 mm (0.059 in.)

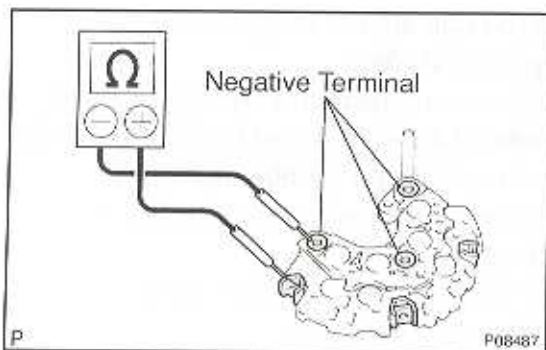
If the exposed length is less than the minimum, replace the brush holder assembly.



10. INSPECT GENERATOR HOLDER W/RECTIFIER

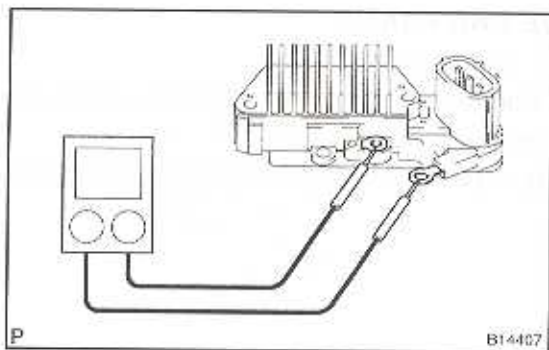
- (a) Check the positive rectifier.
(1) Using an ohmmeter, connect one tester probe to the positive terminal and the other to each rectifier terminal.
(2) Reverse the polarity of the tester probes and repeat step (1).
(3) Check that one shows continuity and the other shows no continuity.

If the continuity is not as specified, replace the rectifier holder.



- (b) Check the negative rectifier.
- (1) Using an ohmmeter, connect one tester probe to each negative terminal and the other to each rectifier terminal.
 - (2) Reverse the polarity of the tester probes and repeat step (1).
 - (3) Check that one shows continuity and the other shows no continuity.

If the continuity is not as specified, replace the rectifier holder.



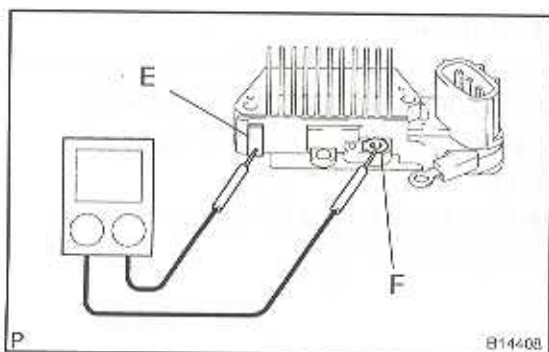
11. INSPECT GENERATOR REGULATOR ASSY

- (a) Using an ohmmeter, check the continuity between terminals F and B.

Standard:

When the positive and negative poles between terminals F and B are exchanged, there is continuity in one way but no continuity in another way.

If the continuity is not as specified, replace the regulator.



- (b) Using an ohmmeter, check the continuity between terminals F and E.

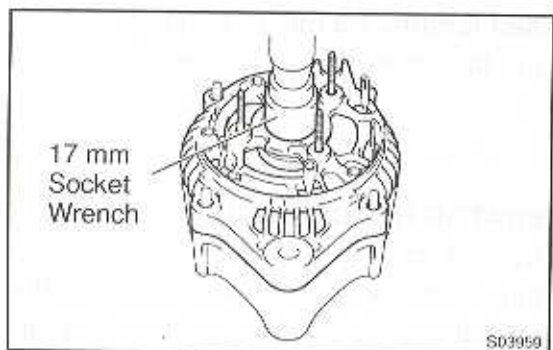
Standard:

When the positive and negative poles between terminals F and E are exchanged, there is continuity in one way but no continuity in another way.

If the continuity is not as specified, replace the regulator.

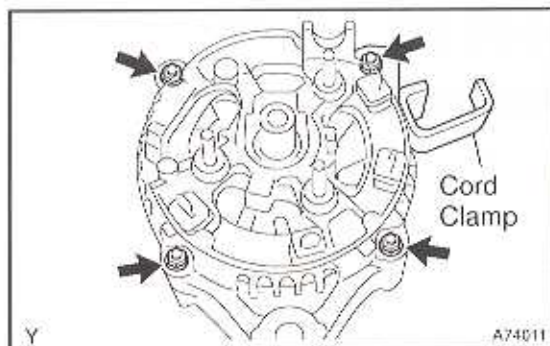
12. INSTALL GENERATOR ROTOR ASSY

- (a) Using a press, press in the rotor.
- (b) Place the alternator washer to the rotor.

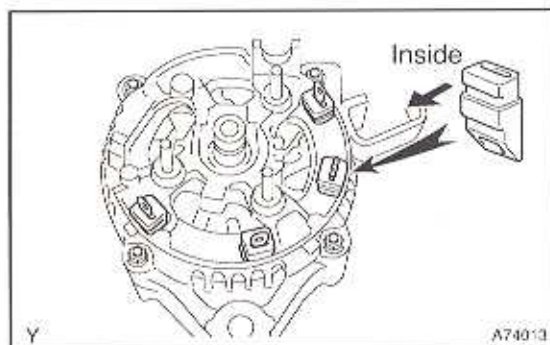


13. INSTALL RECTIFIER END FRAME

- (a) Using a 17 mm socket wrench and press, slowly press in the rectifier end frame.



- (b) Install the cord clamp and 4 nuts.
Torque: 4.5 N·m (46 kgf·cm, 40 in.-lbf)

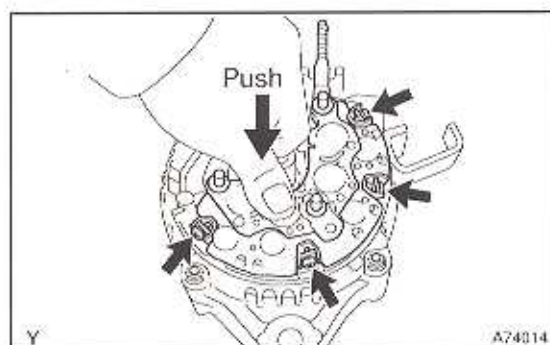


14. INSTALL GENERATOR HOLDER W/RECTIFIER

- (a) Install the 4 rubber insulators on the lead wires.

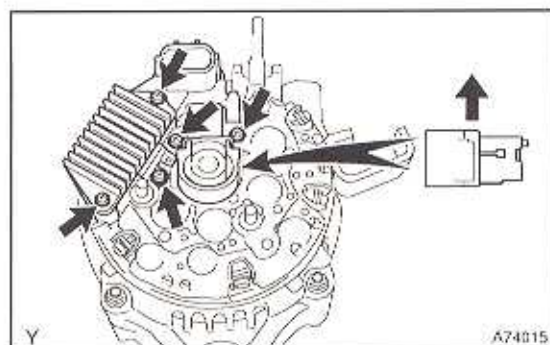
NOTICE:

Be careful of the rubber insulators installation direction.



- (b) Install the rectifier holder while pushing it with the 4 screws.

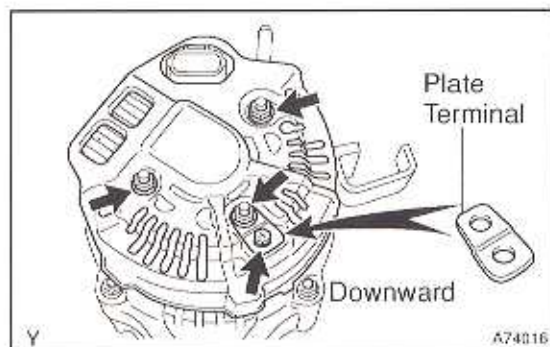
Torque: 2.9 N·m (30 kgf·cm, 26 in.-lbf)



15. INSTALL GENERATOR BRUSH HOLDER AND GENERATOR REGULATOR

- (a) Install the regulator assy with the 3 screws.
Torque: 2.0 N·m (20 kgf·cm, 18 in.-lbf)
 (b) Place the seal plate.
 (c) Install the brush holder assy with the 2 screws.
 (d) Place the brush holder cover.

Torque: 2.0 N·m (20 kgf·cm, 18 in.-lbf)



16. INSTALL REAR END COVER

- (a) Install the rear end cover and plate terminal with the bolt and 3 nuts.

Torque:

4.4 N·m (45 kgf·cm, 39 in.-lbf) for nut

3.8 N·m (39 kgf·cm, 34 in.-lbf) for bolt

- (b) Install the terminal insulator with the nut.

Torque: 4.1 N·m (42 kgf·cm, 36 in.-lbf)